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THE AUTOMOBILE

Garage Costs--A Pertinent Problem

Efficiency Engineer Required for Work

Another problem that is puzzling the brains of motordom is the garage puzzle. On the one hand it is claimed that there is no money in repair work and on the other that prices are out of line. Efficiency engineers like Pharaoh of old, who was sharply criticised for his brick-making activities and the New York contractor who eliminated a number of motions in laying brick, are required in the garage business to install an economic system and to balance the various elements of the industry so that lost motion may be eliminated not only from the cars given into their care, but also from the garage business itself.

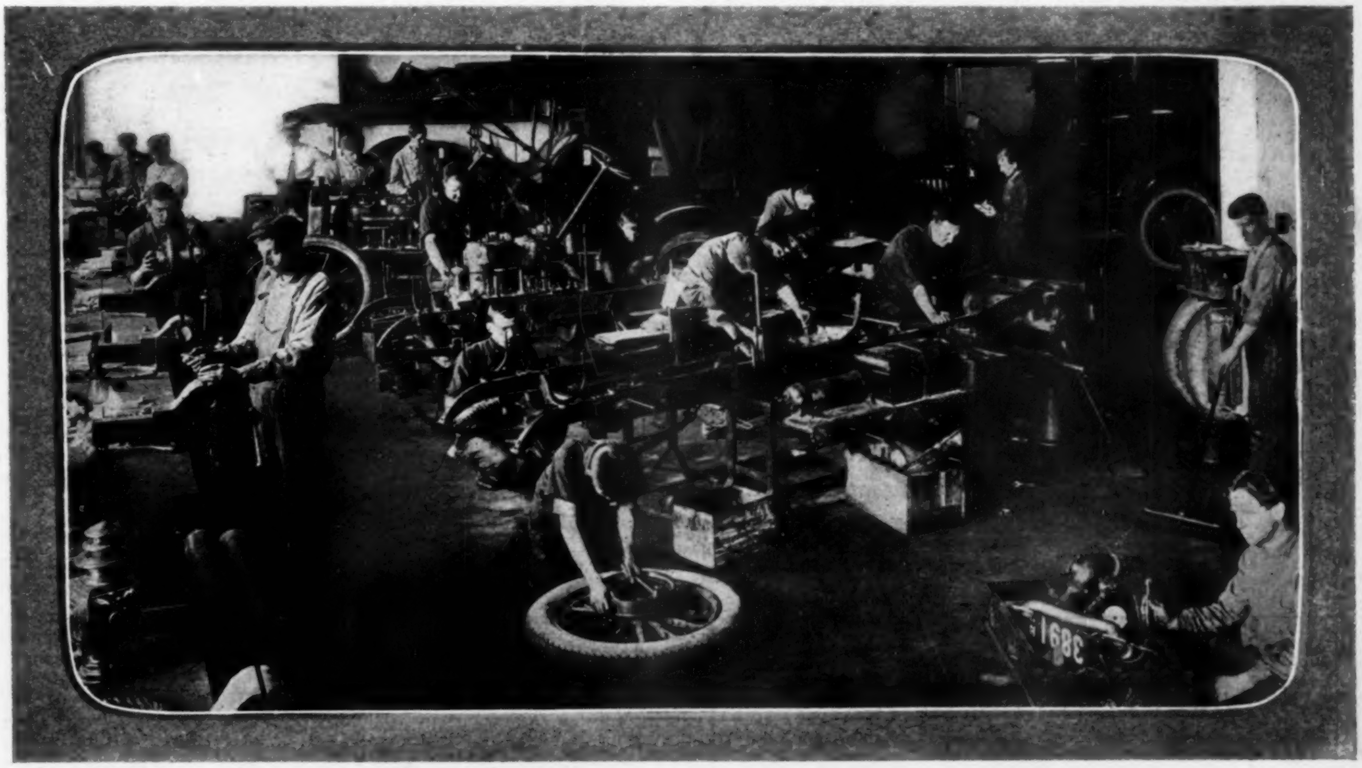


FIG. 1—CONCENTRATING ORDERLY ACTIVITY ON A RUSH JOB IN THE PEERLESS SERVICE DEPARTMENT

KING PHARAOH, the cruel Egyptian monarch who persecuted the Children of Israel by requiring them to furnish their own straw for brick-making and at the same time to turn out as many bricks as they had been accustomed to when the straw was furnished to them, was merely an "efficiency" engineer attempting to demonstrate an economy of operation.

The modern contractor, who a few years ago figured on a big New York job of brick-laying, discovered that he could make little money on the material furnished and still less on his labor bills under the existing conditions of close competition. Therefore he devised a plan by which he could gain time and conserve the quality of work. He found that from time immemorial, it had required seventeen distinct motions to lay a brick. He studied this phase of the situation and managed to eliminate all but five of them, without disturbing the character of the work turned out.

He paid a little more money to his workmen and put the improved system to work. Result: He made a pile of money not only on that job but on subsequent contracts, and besides amassing a fortune, he added something valuable to the store of world knowledge.

King Pharaoh and the contractor were both "efficiency" en-

gineers. Both studied out details of the existing conditions and corrected them so as to add to the wealth and well-being of the world. They injected an additional factor of systematic economy into the problem that confronted them and in a large measure they did just what the "efficiency" engineer of tomorrow will have to do in the operation of the garage.

According to the men who conduct them, garage enterprises are not profitable in a commercial sense. It is also a patent fact that the prices charged to customers for repair and maintenance work are all that the traffic will bear. Therefore, the proposition that confronts the proprietor of a garage is very similar to the one that was presented to the brick contractor and must be solved along the same lines.

In the operation of motor trucks the item of expense for labor put into repair and maintenance work is highly important. According to the experience illustrated in the accompanying series of curves it cost .038 cts. per wagon mile for the pay of garage employees to keep 96 trucks of the three-ton size, including both gasoline and electric wagons in service. It cost .033 per wagon mile to operate each of 111 two-ton trucks and .024 per wagon mile to operate one-ton trucks, the number of which used in the illustration was 126.

Taking the general average cost of operation in this particular, based upon the experience of one year with 333 trucks of the three sizes, it is found to be .031 per wagon mile.

If each of these trucks traveled 8000 miles during the year, the cost per wagon would be $248 per year for incidental labor and repairs and cleaning such as would not require replacements. If the trucks average two tons carrying capacity and carry it throughout, the cost per ton mile would approximate .015.

Garage Income from the Viewpoint of the Owner or Operator of Freight Automobiles

Take for example a garage which has facilities to handle say 30 of these trucks as one of its departments; its total income from this source alone would be $7,440 a year. It is assumed that the cost of labor would be about the same, everything considered, whether the operating company conducted its own garage or let out the work. In fact, it would be practically impossible for a company using only a few trucks to operate its own garage, because of the unlikelihood of a few trucks furnishing sufficient work for a gang of expert repairmen and consequently such a project would prove either cramped for enough labor or glutted with too much. But where as many as 30 trucks can be handled by a garage concern the opportunity exists for a profitable job all around.

System is the answer to the problem. The garage man who would make money for himself must conduct his business according to systematic and economic principles. He must realize that extortion on his part means killing the goose that lays the golden egg, for nothing can be more certain than that the commercial interests will use more trucks and displace more horses if the maintenance of the trucks is made less costly to them. If more trucks are used it spells more business for the garages and more work and money for labor.

On the other hand, exorbitant charges tend to discourage additions to the number of trucks in use and if that line is pursued far enough, it means that some truck equipment might be abandoned.

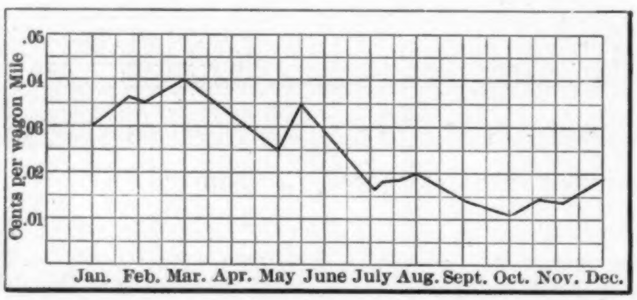


Fig. 2—Garage costs and incidental labor on one-ton trucks is 2 2/5 cents per wagon mile, according to experience with 126 of these trucks

The interest of the garage man and the owner of both pleasure and freight cars is identical. The idea of "soaking" the owner for repair and maintenance work is abhorrent.

Thus the garage man who is wise in his day and generation must eliminate some lost motion not only from the cars that are submitted to his care but also from his administration of his business.

It is far better to direct with skill and understanding the labor of five men than to allow a force twice as large to direct itself. In the one case, it is reasonably certain that the results will be satisfactory, while in the other, nothing can be surer than that there will be dissatisfaction to the owner of the cars and lessened net revenue to the garage man himself.

Take one little instance to illustrate this matter of lack of general supervision. A certain car was taken to a garage for a minor adjustment that would require ordinarily the work of one skilled man for 30 minutes. The man is assigned to the job and spends 10 minutes or more in getting together what tools he needs. Then, just as he is about to begin work, Bill Smith who has been doing some work on another car calls him away to assist him in some process that ought to have been done by Smith's helper. The helper, however, is engaged in finding and sharpening some of Bill's tools. Consequently the first man spends half an hour assisting Bill. Then he resumes his work on the customer's car and finishes it in 20 minutes. By the time he has returned his tools, an hour and a quarter have been spent and a bill for about $1 is sent to the customer for a job that was not worth more than 50 cents at most.

Possibly the customer does not know now what the job was worth, but in time he will learn and then he will be in a position to ask some embarrassing questions. In the case of pleasure cars such practices might go on indefinitely but in the matter of trucks, where every penny is scanned and pinched, the business of such a garage will most certainly feel the effect very shortly.

What the Efficient Garage Should Contain to Produce Best Results

Assuming that the physical conditions of a first-class garage have been met and that the place is of sufficient size and has enough stock, supplies, parts, jigs, tools, etc., and has a force large enough to handle its work, the question that remains is how to use it to the best advantage so that the garage man may make some money and the use of the automobile may be fostered by reasonable charges for repair and maintenance work.

In the first place there should be a stock room in charge of a responsible man and conducted so that absolute responsibility shall rest upon him. This should be arranged so that no time shall be lost in finding any required item in stock. A careful inventory should be made not less than once a month to determine the exact amount of stock on hand and to provide for replenishments when required.

Not so much as a cotter pin should be issued from the stock room without an order signed by the superintendent or foreman of the repair department and the total of these orders should be checked against the monthly inventory. In addition to this inventory, the man in charge of the stock room should clean and cover his stock at least once a month, to prevent loss.

The tool room should also be a separate department, carefully isolated and preserved under lock and key. There should be a man in charge and if the shop is large enough, a helper to assist him. In this department all the movable tools should be kept so that they will be available instantly.

Aside from issuing and receiving these tools on order of the foreman, the man in charge should be required to keep all the tools in first-class condition, sharp and ready for service. A pneumatic cleaner is one requisite of this department, but the tools should be returned to the man in charge after being made

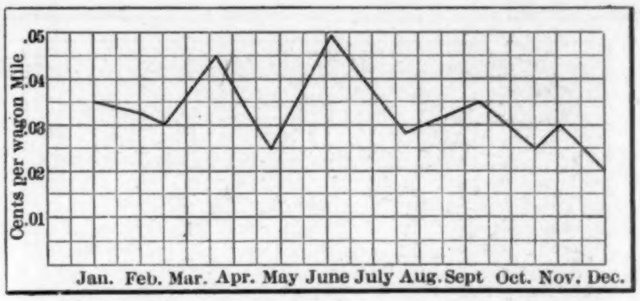


Fig. 3—Judging by a year's experience with 111 two-ton trucks the cost of garage work per wagon mile is 3 3/10 cents

reasonably clean by the workman who drew them for his use.

Then when a car is brought into the repair department for any kind of work, the foreman is able to decide in short order what is needed under his instructions. He directs as many men as necessary to draw certain tools and certain items from the stock room and without any appreciable delay it is possible to commence work. If the foreman knows his business all the tools that will be required can be put at his disposal in one minute, and in an ordinary job the supplies from the stock room will be available in less than another minute.

The straightening of an axle, seating of valves, ignition adjustments, taking up of lost motion in some definite particular, replacements of bearings, may all prove to be either big or little jobs under any circumstances, but the big ones will be less and the little ones will be trifling if the men, tools and supplies are available and the work is done under intelligent direction.

The ramifications of a system such as is necessary in garage work are too wide for a comprehensive outline here, but the general principle may be declared and emphasized. The plant should be comprehensive in size; the force should be large enough to handle the work but not so large as to place a premium upon "soldiering"; the stock should be ample with regard to due care so that a lot of useless surplusage may not encumber the shelves and add to the proper work of the man in charge of that department; and charges for service should be reasonable.

But all these things will be useless or worse unless the right man is in charge. There is altogether too much haphazard endeavor in this particular and much of the complaint made by garage owners as to small profits or actual losses is undoubtedly due to the fact that they do not have the right men in charge or else they do not allow those men to use their discretion in instituting reforms of practice.

How the Interests of the Owner and Garage Man Go Hand in Hand, and Why

If the average cost of truck owners is $248 a year for garage work, it means that at the rate of 75 cents an hour, each car requires about one hour's work a day for one man, a trifle less than that time being the average of the general run. If the capacity of the garage is 30 trucks, that would mean about 27 hours' work a day for one man or a straight nine-hours a day for three men, working six days a week.

While the trucks represent but a single line of endeavor in the garage business, it would be just to charge half the pay of the man in the stock room and half the pay of the men in the tool department, the full pay of a foreman and one-third of the pay of the superintendent against the business of the trucks.

This should total about $20 a day, or $6,200 a year, against a total business of $7,440 for labor alone. Replacements, supplies, etc., would add a total of about $320 per car or $9,600 for the 30 cars during a year's service. Of this an item of 10 per cent. net should be profit. Thus on the operation of the truck maintenance and repair department of an intelligently conducted garage, the net profit from operation should be in the neighborhood of $2,200 a year. In connection with the repair department for pleasure cars, storage, ordinary garage service and the various things and elements that go along with it, it is not difficult to conclude that there is a profit in the business if it is carefully handled. In an enterprise of all-around activity that had a truck department of the size referred to, it would not be too much to say that its pleasure car repairs and replacements ought to net close to $5,000 and that its live storage facilities should bring in not less than $15,000 a year gross, $12,000 of which should be net profit. The sale of gasoline, oil and accessories should add about $2,500.

Thus the total net revenue of a first-rate place of this size and character should be in the neighborhood of $21,700 a year. Against this the proprietor must deduct his rent, interest, depreciation and replacements to plant and other expenses and his clear income should be in excess of $10,000 a year, if he owns the whole enterprise.

Such a place would give steady and profitable employment to 15 men. If the proprietor served as superintendent, with say a one-quarter interest in the business, his income would be not far from $5,000 a year and the concern would pay a ten per cent. dividend annually upon an investment of $100,000. With a capital of $100,000 a competent man could run a pretty big garage enterprise, much larger in fact than the one outlined above. As a matter of fact one-quarter of that capital properly administered would probably serve adequately. If the proprietor actually invested $25,000 in such a business and served as superintendent of all its departments, his return would be fully 50 per cent. of his investment annually.

The figures cited above are based upon the experience of several garage enterprises, except for the fact that systematic economies such as have been suggested were not in operation. One of these concerns, it is stated, is conducted at a loss of $200 in the repair departments, instead of a profit of $3,800. At the same time its profits on parts and replacements were $7,000 against $3,400, as in the illustration. The storage profits were less than $9,000, while the profits from sale of gasoline, oil and accessories were in excess of $5,000.

Why a Deficit Is Shown Where a Profit Would Be More Reasonable to Expect

In regard to the striking difference apparent between a profit of $3,800 in the repair departments against a loss of $200, the trouble lay in the fact that the men were improperly directed and the force was too large numerically for the amount of work in hand. This particular garage made a specialty of its promptness in turning out work, but it did not have its truck and pleasure car repair departments separate.

There may have been some connection between the excessive profits realized from the sale of parts, gasoline, replacements, etc., and the deficiency in the revenue from live storage, because after all there is such a thing as competition in the garage business just as there is in everything else in human life and when a car owner finds that it costs about the same to store his car in all good garages and that the prices charged for repairs, replacements, gasoline and supplies varies, he is naturally more likely to give his work to the concern that charges less money, equal work and quality being considered.

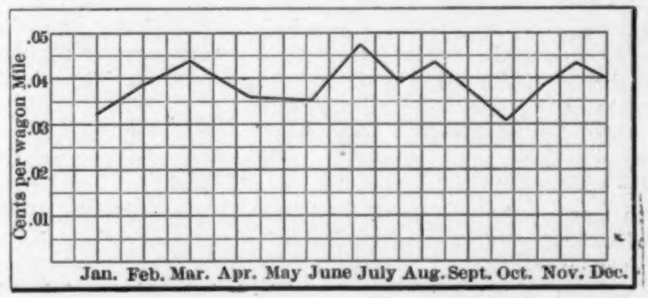


Fig. 4—Three-ton trucks cost 3 4/5 cents per wagon mile on a basis of 96 trucks in service for a full year

Fig. 5—Ideal arrangement of machine tools without restriction of space

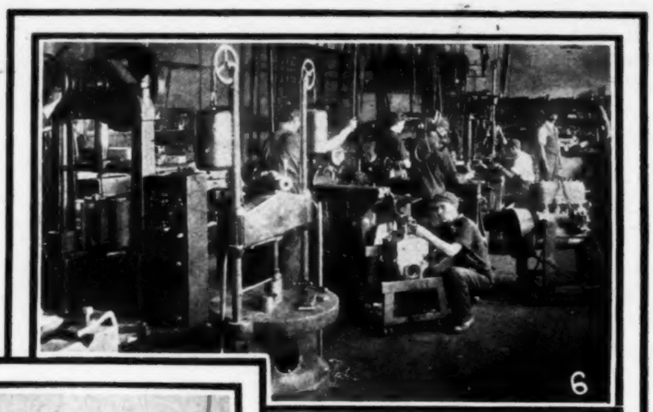


Fig. 6—Showing how restricted space may be utilized advantageously

Fig. 7—It required an "efficiency" engineer to devise this method of saving time and labor

In one of the other garages examined, both the supply and the repair departments were run at a loss and the profits came from storage alone. Poor management of the men and a bad system of checking the supplies was indicated by the disorder that obtained in this place. What was needed was a man who could install a system of efficiency.

In another the force was too small but the repair departments showed a good profit on account of the excellent system that was in force. By the addition of two more men the income from these departments could have been increased materially and much more satisfactory service could have been given to the owners of cars. The prices charged for extra parts and for overhauling was reasonable and if the superintendent had been given a little more latitude in the matter of employing help, the concern would have made a better showing.

In solving this problem to the mutual satisfaction of both sides, the garage man and the car owner, the fullest array of facts is necessary. The man who can do so must be an efficiency engineer of a practical order. He must weigh and balance each element and use a discriminating nicety in taking a little from one side and adding to the other so that a round and satisfactory result may be obtained.

He must realize that in the broadest sense the business is competitive, and when he finds that a certain phase of the business is getting away from his house, he may know that either his prices or his quality are out of line. If on the other hand he finds that he is being overcrowded with a certain type of work and that other concerns are not, he may rest assured that his price is too low or the quality of his work is better than that of his competitors. As the quality of work may be assumed to be practically equal in all first-class places, he will probably find that the price makes the difference.

The ideal condition has been reached when the storage department earns its maximum income and both the pleasure car and the truck repair departments have all the work they can do and no more, and the concern is obliged to keep a steady stream of orders going to the factories and supply houses in order to maintain the level of stocks.

It will probably be quite a while before this condition is realized generally, but it is a practical certainty that the pioneers in the line of efficient service will attain it long before the bulk of the garage concerns that operate on the haphazard plan.

Periodically the complaint is made that the cost of extra parts is too high. Take for instance a truck that costs in running condition $5,000. If one were to try to buy the parts contained in the assembled car he would find that the total cost would be in excess of the list price of the car. And this in spite of the fact that it is said to cost $400 to assemble the parts. There is apparently something wrong with such a condition and in the course of time it will correct itself. But a good long step toward general improvement of the situation could be taken if a more reasonable view of the matter should be assumed by the manufacturers.

Then, too, the situation could be cleared infinitely if the garage men would only see that a reasonable profit on a big business is better than an exorbitant profit on a small one. The more automobile operation is fostered and advanced by making operation more reasonable, the better it will be for the garage man, because it means more business and more cars.

On a basis of 10 per cent. net profit on supplies and parts; 15 per cent. on labor and wages, and the storage profits, the garage business presents an attractive proposition to those who understand it in a detailed and practical way. These things are all attainable by the use of proper system despite the rather general complaint that there is nothing in repair work.

While it is not quite so apparent that an added element of "reasonableness" in garage charges would increase the volume of passenger or pleasure car business very largely, it is certain that any economy in truck operation must have an immediate effect upon manufacturing. Undoubtedly the owners of passenger automobiles are alive to economies in cost and improvement in the quality of garage work, but a fraction of a cent per wagon mile saved to the owners of trucks may result in the addition of dozens of trucks in the service of a single house. This means hundreds in one industry and thousands in one community and hundreds of thousands in the country.

If it costs a certain sum for this item of operation under haphazard management of garages, it is more than reasonably certain that the cost can be reduced by skillful management. The reduction of cost to the man who pays the bills may not be the prime object of the repairman, but when an orderly and efficient system has been installed in a garage, the effect of eliminating lost motion must needs have some effect upon the level of prices.

The day of the bonanza is past and gone. The garage man cannot get rich by charging a few customers exorbitant prices and returning to them uncertain service. If there is any element of weakness in his system he cannot hope to make much money even from a contract that seems to be large and profitable on its face. Competition has taken care of the bonanza prices, and the garage man who would make money and achieve success must look for his profits in economies, and the most telling economies are those that tend to automatically secure the maximum of use from his plant and workmen.

A definite system that will take care of numerous details and account for every minute of time and penny's worth of stock is the answer.

In the future the garage business is going to be very much the same as any other large manufacturing business. The cost to owners is going to be standardized very closely and the shop with the larger facilities and able to handle a large business will make more money than one only a degree smaller in size, quality and other things being equal.

The immense shop, equipped with the most modern devices for handling every phase of the business according to the most economical and systematic plan, will have the advantage in the total amount of business done and revenue earned, but the smaller shops conducted on the same principles will be able to compete and will be at no proportional disadvantage in the matter of revenue.

But the first step toward reaching this condition must be a full understanding of the relation the garage man bears toward the manufacturing end of the industry. When this is thoroughly understood and the ultimate welfare of the whole business is given its proper weight, the rest will be a mere matter of detail. Step by step this will be worked out, until the result inevitably must be that self-interest on the part of the repairman will point to economic operation of garages under such a system as will conserve a maximum of energy and industry at a minimum of cost.

The accompanying series of photographs illustrating some of the recent developments along the lines of system and order were taken in the service departments of the Peerless Motor Car Company and The White Company, in New York.

What the Britons Are Doing

News notes of interest from the "tight little isle" having to do with things appertaining to the automobile, which will play a not unimportant part in the coronation of King George V, scheduled for the present week.

ALTHOUGH it is but nine years since the coronation of King Edward VII was solemnized, attention is being called to the fact that even at this period of the automobile history, as recent as it is, "the motor car was branded as a thing unclean." It is also worth while mentioning that although the automobile was legalized on British roads as early as 1890, motoring, both as a pastime and a commercial convenience, was still in swaddling clothes as late as 1902. It is true that the Royal Court officials tabooed the use of automobiles for use in the King Edward VII coronation procession. But it is questionable, even had this not been the case, whether any insurance company would have had the temerity to guarantee the guests motoring to the Abbey against the risk of arriving late, the opinion at that time being that the company would have been a heavy loser. What a contrast to-day! One of the striking features of the King George V coronation parade is the festooning of the automobiles for use on this occasion.

Hampshire, near Manchester, England, has become such a popular center for automobiling, that the rapidly increasing number of machines have the effect of frightening the horses along the roadways. Consequently, everybody who is able financially to shoulder the expense is going in for an automobile of his own. Such a number of very wealthy recruits have already joined the ranks of the automobilists that certain of the highway officials think seriously of having laws passed making it incumbent upon them to build a turnpike system of their own between Bournemouth and London, to be maintained at the expense of owners of motor cars.

Tube-and-omnibus tickets combined, affording an allied tube, tramway, motor bus and railway book of "franks" are now being issued in London. These allow the passenger to avail himhelf of a quadruple service, and for which a running scale of prices is charged, from one penny to sixpence.

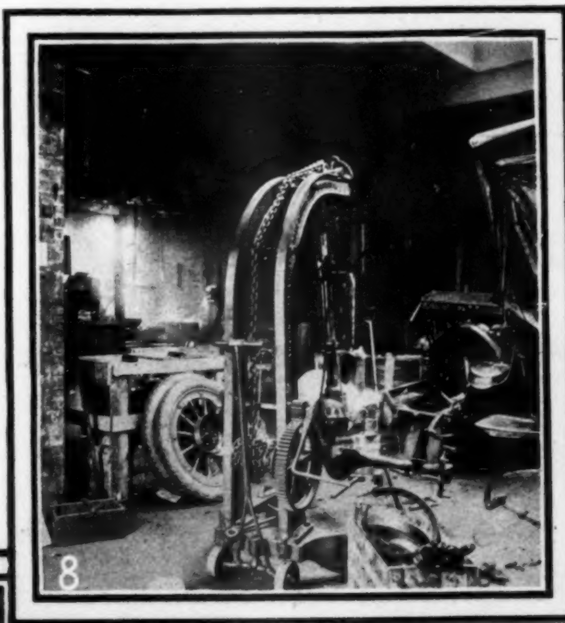


Fig. 8—Disorder as shown here is one of the problems that must be solved if success is to be attained

Fig. 9—One way of storing spare parts and stock with a view to economy and availability

Fig. 10—A small rush job should not attract the attention of the whole working force as here shown

S. A. E. Holds Greatest Convention

Serious Thought Keynote of Dayton Meeting

From Thursday until Saturday last week the Society of Automobile Engineers held convention at Dayton, Ohio. Practically half of the membership of the society was present at one or more of the sessions, setting a new high water mark in that respect. The whole program, business, professional, social and supplementary, was run off without a hitch, and the most notable thing about the convention was the added element of seriousness that was apparent about the proceedings.

DAYTON, OHIO, June 19.—With practically 50 per cent. of its entire membership present, the Society of Automobile Engineers held its most successful meeting last week. There seemed to be a different atmosphere surrounding the convention which opened last Thursday and remained in session until Saturday, than that at any of the former meetings.

Not only was the attendance large and representative, but those who were there came for serious business. It was about as different from a trade convention as possible. The business and professional sessions drew attentive audiences of large proportions and the discussions of the various papers presented formally were more spirited, general and typical of the great industry than those of previous sessions. It is estimated that the maximum attendance at the convention was about 300.

Aside from the sessions an elaborate supplementary program ranging all the way from inspection of factories to formal and informal dinners and theatrical amusements had been prepared, among the features of which were the following:

In addition to a visit to the National Cash Register Company, followed by a run by automobiles to Simms Station, the "stamping grounds" of the Wright Brothers, where a splendid flying exhibition was made, provision was made as follows: The Apple Electric Company kept open house. The Buckeye Iron and Brass Works was visited. The Dayton Auto Works exhibited its trucks. The Dayton Engineering Laboratories Company fitted up a room for the examination of its products. This company is demonstrating some very interesting phenomena in connection with the benefits and difficulties going along with induction. The Dayton Malleable Company went on record. The Dayton Motor Car Company is wide open and a number of its cars were placed at the disposal of the members. The Dayton Rubber Company was visited. The company served a luncheon. The Hoban Brass Foundry was visited. The Mead Engine Company is showing several rotary valve engines. Other visits were to the Myers Auto Top, the Speedwell Motor Car Company and the Troy Company. The entertainment for Friday evening was by a very good "stock company" out at the edge of the city, and the Chamber of Commerce obtained 200 seats which were given to the members.

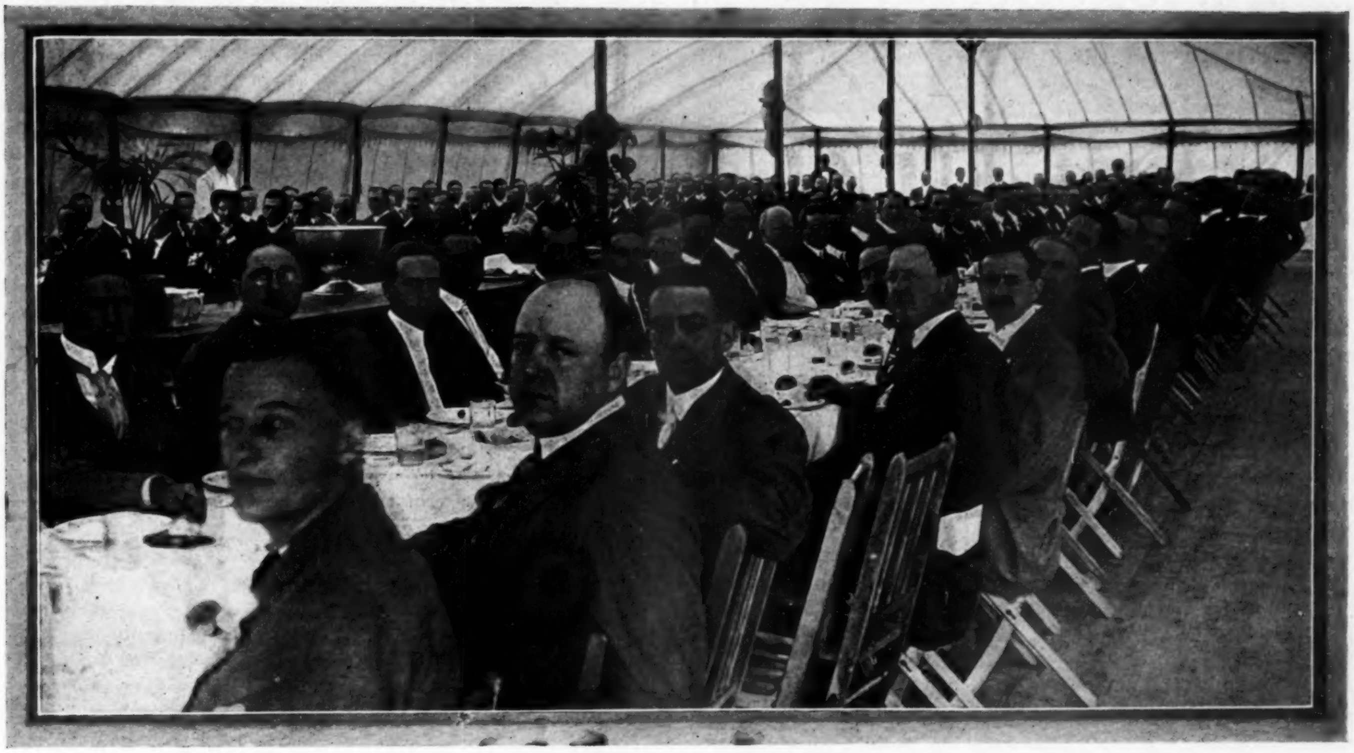
The banquet at the Automobile Club Saturday afternoon was an enjoyable affair.

Discussion of the Papers Presented

PRESIDENT: (Opening) Gentlemen, we find ourselves in the city of Dayton for our midsummer convention. . . . It gives me great pleasure to introduce Mayor Burkhardt of the city of Dayton.

MAYOR EDWARD E. BURKHART: Mr. President and gentlemen of the convention, . . . it is usually customary for the mayor

Annual convention of the Society of Automobile Engineers in the Sun Room of the Hotel Algonquin, Dayton, Ohio



Fully two hundred members of the Society of Automobile Engineers sat down for luncheon under the big marquee

to come to gatherings of this sort and deliver the keys of the city. It is hardly necessary in Dayton to go through that formality because an accurate census has demonstrated the fact that there are no locked doors. If you should find one, just put your shoulders to it. . . .

PRESIDENT: I am sure we have all been very glad indeed to have the mayor of the city welcome us in this manner.

MR. CLARKSON: The item, Reports of Tellers of Election of Members, is simply a signed report announcing the election of about 300 members.

The Treasurer's report followed. It was moved and seconded that it be accepted and placed on file.

MR. CLARKSON: The next is the announcement of the vote by the membership on the matter of amendments to the constitution (revised in accordance with a previous vote).

PRESIDENT: Unless there is some discussion regarding business matters which you have just mentioned, we will now pass along to the professional matters which interest us so very much more, I think. The first technical business to arise is the second report of the Iron and Steel Division. If you will glance at the names of the committee you will see that the committee has been composed of producer and consumer. . . . It is desired that this report have the widest consideration. The society is here and the report is before you. It has been passed and voted upon by the Subcommittee; passed through the hands of the Standards Committee and accepted by them, and through the council; it is now in your hands for treatment. I hope that the discussion will consider just as far as possible the specifications as such, first; and then, if you care, take up heat treatments and the other remarks in the pamphlet in the nature of instructions. The question is open.

MR. NORRIS: The specification, I understand, that is all you care to have discussed at present?

PRESIDENT: Well, go as far as you can.

MR. NORRIS: A number of steel manufacturers, who have recently become members of this society, have gone over these specifications and there are certain changes in composition which they thought would meet the commercial practice a little better than this. And those changes were presented to the chairman of the Subcommittee and I presume were discussed yesterday.

PRESIDENT: No; that was not discussed yesterday, because we couldn't get you, and because the ones who made the comments did not appear. It seemed only fair to reserve that until all were present.

MR. NORRIS: In view of those changes, some of which were considered to be good, that this report might have been referred back to the Subcommittee for additional changes before being presented to the society. The chairman has a list of those changes that were suggested, and I think it is hardly worth while discussing the changes here, but refer this back to the Subcommittee for discussion there.

PRESIDENT: You have heard the remarks of Mr. Norris; and the committee received the communication after the report had been passed up, and it was thought that the best place to get at this whole matter is here before a large membership. I think it would be wise if Mr. Norris would take the comments in detail as stated by him in his letter and put them before us. I would suggest that the matter be handled here.

MR. NORRIS: As a matter of fact, these specifications with very minor details, are already in the transactions of last January, except as to some very minor changes, so that I don't think the manufacturers will be put to any hardship if they do not receive this specification in its present form, as they already have it essentially in this form.

PRESIDENT: Have you a copy of these comments?

MR. NORRIS: I have the principal memoranda on the specifications. In the first place, on page 1, in the second paragraph, the specifications indicated read, "Any shipments not conforming to these specifications after careful check analysis may be rejected." The objection is made that some clause should be inserted there as to the manner of sampling whether, for example, it should be half way between the center and the end; and also the number of parts to represent the shipment.

PRESIDENT: My thought is that we talk them over and dispose of it one at a time.

MR. NORRIS: At the top of the page is a picture, in the specification itself. It is thought that we might just as well save that space, as it does not refer to anything in the specification. In the specification No. 1 the comment was made to leave out all reference to silicon; that practically meant nothing and

might just as well be left out; and to increase phosphorus from .04 to .05; that will include 1, 2, 3, 4, 5 and 6. And then specification No. 4, to change the carbon in it and fill in the missing link between 3 and 4. No. 3 reads .25 to .35; No. 4 reads .40 to .50. Insert there .35 to .45 and put in an additional specification to carry it from .4 to .55. The steels, ranging from .35 to .45, are a very important class of steels, and they are not mentioned in these specifications at all. Then the next changes are found in specification 7 to eliminate the silicon specification and change the nickel from 3.25 to 3. The specification No. 8 and No. 9 is a range of carbons that has a very wide application, they are not mentioned in these specifications and it was suggested that the specification be enlarged to take in .35 to .45. In specification No. 9 the nickel in it should be changed to 1.25 instead of 1.50. In No. 10 I propose nickel at 3 instead of 3.25 per cent. and adjust the carbon range. Then, specification No. 11, you change the carbon from .30 to .40 on account of having to insert this other steel; and change in nickel and chromium to read 3 instead of 3.25 and 1 instead of 1.25. And specification No. 12 to change the nickel to 1.25 instead of 1.50, and the chromium to .7 instead of .8. And in No. 13 change the manganese to read .40 to .90 and the chromium to read .75 to 1.25. The specification No. 14 to have the manganese read .40 to .90; and the chromium the same as in No. 13, from .75 to 1.25. The specification No. 15 to change the carbons to fill in the blank between No. 14 and No. 15 to read .35 to .45, and the manganese as in No. 14 and No. 13 from .40 to .90. And the phosphorus and sulphur to read .05 instead of .04. Chromium to read .75 to 1. Then there is another vacant space. There is another range of steel above the specification No. 15 that is not covered—the .45 to .55. I will say that class of steels has a very wide application; and in specification 16, silico-manganese steel, have it read .50 to .60. The specification No. 17 insert under that heading; the steel to be made by any steel-making process or specification, Bessemer, open hearth or electric crucibles. In specification No. 18 cut out the explanatory paragraph at the top as hardly belonging there. It would eliminate silicon in the specification.

Mr. Gormally: As a member of the iron and steel committee, I should like to know why some information as to all of this data was not presented before.

Mr. Norris: That was suggested a year ago. There were four representatives of the steel manufacturers or men who were actively engaged in the manufacture of steel. Three of those four represented steel works where crucible steel or electric furnace steel was made and the manufacturers of what you might call the ordinary commercial steel was not represented on that committee at all, until after the January meeting, when the committee was enlarged to take in a representative of the Pennsylvania Steel Company and a representative of the Union Steel Company, and as near as I can find out the companies were not represented before that. They knew practically nothing about these specifications until after they were in printed form.

(At this point Mr. Coffin took the chair.)

Mr. Henry Souther: As chairman of this committee, I would like to make a statement of this situation. As to the manner of taking samples and the idea of drilling half-way between the outside and inside of the bar of steel; that is right, where you can do it. The committee considered printing such a statement, but we found there was no statement of that kind that would cover every form and shape of material. Each consumer must take his own samples in his own way and with intelligence, otherwise they will not be worth anything anyhow.

The next objection raised was the placing of the cut of a tensile specimen where it is. Possibly that need not be there. It might have a better place in the instructions or notes, but we do want the members to know what a standard specimen is. That is the entire purpose of that. I am sure there will be no objection to moving the position of that cut.

The next suggestion is in regard to phosphorus .04 stands printed. That was discussed by the committee and was placed as being a limit which manufacturers can meet at a fair price, if they will. As it is we have to accept goods that run by accurate chemical analysis .005 above that. In other words, .045. If we place that limit at .05 as suggested, then we will find ourselves likewise in the way of the proposition of accepting .055. I do not believe there is any reason for changing that limit, and I do not believe that the cost of steel need be one bit greater with .04 than with .05.

The remarks on sulphur are precisely the same. It is true that sulphur exerts small influence in the cold condition, but in the hot condition it exerts a large influence—.04 is a fair limit.

The next reference is to silicon. As it stands, it is .20 and for a very good reason. There are steels in the market that run as high as .4, .6, .8 and a purchaser might find himself in a position of having in his possession, purchased, in accordance with this specification, steel which he supposed was low silicon, but which the maker had on hand in high silicon and gave to him. It is not a fact that steel containing .4 and .6 of silicon will behave the same as steel containing less than .2 of silicon. I therefore consider that that specification is not dead-wood. It is simply a protection against irregularity. It may be true that steel containing .4 silicon can be made to produce the result of .2, but not in the same furnace and at the same time.

In the nickel specification instead of having .50, that is, one-half per cent. leeway, three-quarters of a per cent. is suggested. That is merely opening the door toward carelessness.

The next suggestion was that an additional nickel specification be injected. That is all right. The same remarks that would apply to carbon steel apply here. Wherever additions are suggested there can be no objection except that of complication.

The next item of importance is the changing of manganese limits from .60 to .90, making it .40 to .90. Here, again, the attempt is made to open the door to give the producer a wider variation. I believe it is safe to state that a bar of steel of .40 manganese treated side by side with a bar of .90 manganese will not give the same results. It is dangerous to do that, and if we must have that range of specifications, if there are those that want .40 to .70, and then .70 to 1, we must inject more specifications, but I do not believe it is right to widen up the manganese limits to any such extent as suggested.

There is one more subject that is provoking wide comment. That relates to specification No. 17. The statement appears that screw stock is not safe for the vitals of an automobile. That statement is based on the fact that many samples of screw stock are found containing a great deal of phosphorus. You will note that specification No. 17 calls for phosphorus not to exceed .16. Now, .16 is too high for a good steel. But that limit was placed with the idea that many producers were furnishing steel as high as that, recognizing the fact that many producers did not furnish screw stock steel as high as that.

Mr. Norris: Mr. Souther says that there is no more difficulty in getting phosphorus down to .04. There is difficulty in getting it down to .04 in the open-hearth steel process, and there is great difficulty in getting it down to .045, especially where the steel is made by means of gas. Now acid open-hearth steel is a very good product and there is absolutely no reason why you should shut the door on it, and if .04 is the limit, why take .045? If .05 is the limit, why can't you depend upon the chemical analysis and reject it if it is beyond .05? Why not throw it out if it is beyond .05?

Now, in the basic steel the silicon .20 is absolutely deadwood, because you won't get silicon at .20 or anywhere near it, and as a matter of fact you practically never get silicon near .20 by any process. Even the crucible process will hold below .20. You will not get the high silicon steel at the same price. In the matter of increasing the manganese from .40 to .90 the first specification in which that shows up is No. 15 on the chrome vanadium steel. And that is in a way two distinct classes of steel named. One class of manufacturers believes in the lower manganese; the other class believes in the higher manganese, and that was the reason that the change was suggested.

CHAIRMAN: Gentlemen, I think that perhaps it may be a little enlightening to a good many of those present if we were to read extracts from a couple of letters. The beginning of the letter, over Mr. Norris' signature, dated May 16, and Mr. Southers' reply thereto, dated May 19. (The chairman, Mr. Coffin, then read Mr. Norris' letter.)

In reply to this letter Mr. Souther wrote (Mr. Coffin then read Mr. Souther's letter).

I think that in this discussion this morning we are getting down to the real meat of the situation. According to indications there has been some reticence on the part of the steelmakers to enter into the spirit of the work which we have undertaken in the Society of Automobile Engineers. There has been an impression in some quarters that these specifications wouldn't mean very much anyway, and that, further, the direct expression on the part of some of the steelmakers that they couldn't get any benefit to them as manufacturers in giving us any information along this line.

MR. LOTHROP: In discussing these specifications steel is used in automobile construction for the purpose of developing in the various parts a given amount of strength, toughness and resistance to fatigue. It therefore is the intention of any set of specifications governing this material to protect by the use of these specifications the user in such a way that he will obtain in his product a given strength, toughness and resistance to fatigue.

During the past three years we have tested in our laboratory practically all of the nickel steels made in this country and abroad. These tests have been performed in a most painstaking manner, and I have gathered together from our test data sheets a table which I trust may be of some interest and may be instructive in regard to specifications for steels for motor cars. The tests reported in this table are tests of nickel steels made by the acid open-hearth process, the basic open-hearth process and the electric-furnace process.

Your proposed specification No. 8 calls for the following composition:

Carbon	.25% to .35%
Silicon	not over .20%
Manganese	.50% to .80%
Sulphur	not over .04%
Phosphorus	not over .04%
Nickel	3.25% to 3.75%

In my table the 15 different steels tested vary in composition within the following limits:

Carbon	.25 to .30
Silicon	below .20
Manganese	.55 to .75
Phosphorus	below .035
Sulphur	below .035
Nickel	3.40 to 3.70

You will note that in every case the variation in the composition is less than that specified in your specification for nickel steel. A careful study of the table shows that, depending upon the process used in the melting of the steel and depending upon the mechanical manipulation in the fabrication of the steel, we obtained variations as follows:

Elastic limit	130,000 to 195,000 lbs. per sq. in.
Maximum strength	160,000 to 210,000 lbs. per sq. in.
Elongation in 2" from zero % to 14%.	
Reduction of area from zero % to 60%.	

It may be well to impress here that the heat treatment of these steels was the same in every case and that a thermal investigation of the steel showed that this heat treatment was a good one for the steel tested. The practice used was to heat to the hardening temperature of 1550 deg. F., hold at this temperature for 15 minutes, quenching in lard oil and draw the temper at 600 deg. F. for 45 minutes.

The automobile manufacturer is not interested in carrying in his car a certain percentage of any given element, but is more interested in carrying in the vital parts a known amount of strength and toughness. Your specification for nickel steel as it stands does not guarantee the user a given strength or toughness. These two important qualities will vary with variations of composition within this specification and with the process and mechanical manipulation used in the manufacture of the steel. The effect of the process used and the mechanical manipulation of the product in its manufacture are much more important than are commonly supposed. I believe that as a method of inspection of the material received from a steel mill chemical analysis is a most valuable thing.

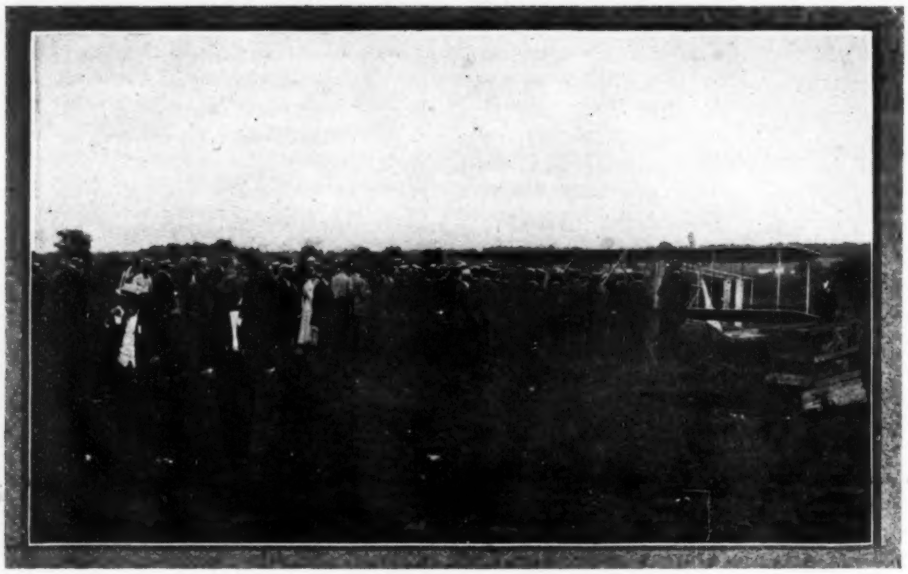
Effect of Process and Mechanical Manipulation Upon the Physical Properties of Nickel Steel

All steel tests were within this specification:

C	.25 to .30	P	below .035
Si	below .20	S	below .035
Mn	.55 to .75	Ni	3.40 to 3.70

No.	Elastic Limit, Lbs. per Sq. In.	Maximum Strength, Lbs. per Sq. In.	Elong. in 2 Ins.	Redⁿ in Area.	Remarks.
1	175,000	210,000	14	60	1550° F.
2	140,000	180,000	10	43	Oil
3	147,000	200,000	8	37	600° F.
4	130,000	175,000	13	38.5	
5	160,000	205,000	14	50	
6	170,000	210,000	12.5	45	
7	165,000	209,000	12	58	
8	195,000	200,000	0	0	
9	170,000	206,000	11.5	57	
10	130,000	160,000	14	60	
11	165,000	190,000	14	60	
12	140,000	170,000	13	57	
13	160,000	190,000	11	50	
14	176,000	207,000	5	16	
15	170,000	200,000	10	52	

Group photograph of the Society of Automobile Engineers in front of the office of the National Cash Register Company, Dayton



Many members visited the "stamping grounds" of the Wright Brothers at Simms Station

MR. FAY: In view of this obvious division of steel men in their opinion I would think that we ought to ask them to guarantee some physical properties alongside of the chemical composition.

MR. NORRIS: That paper of Mr. Lathrop shows why it is impossible to give a specific heat treatment. Each one of those fifteen manufacturers would be free to give the heat treatment which he considers proper for his own steel, and with his heat treatment which one of them is shown to be right?

MR. LANDAU: In regard to physical properties of materials, it seems that about a year ago, at the meeting, some one ventured to offer the suggestion that we embody also in these specifications the physical characteristics, we brushed it aside—that it was impossible to specify about that. I see that Mr. Fay has stated that physical properties are very important, and likewise Mr. Lathrop.

If I were to design a structure of car, the real issue that would appeal to me would be the physical property of the material, regardless of its chemical nature. I appreciate the steel maker would like to have the chemical specification, but on the other hand, how am I to know from this specification the physical properties? If I were to carry a fiber stress of fifty or sixty thousand pounds, I might decide to change the material, because I am not sure that any of these will do. I might expect a .30 carbon steel for thirty thousand pounds. Nothing is said about the physical properties. Mr. Lathrop indicated the fact that the physical properties are so liable to vary with the same composition of materials, what assurance have we got, if we order specification No. 7 or 8, that the material will give the physical properties according to the matter in hand? While we have an interest in the chemical composition, speaking from the point of view of the designer, the subject of composition is almost secondary to the physical properties. I think we ought to specify some reasonable physical limits to the steel maker.

MR. SOUTHER: This same question was raised at the last winter meeting, and the attempt was made to get just exactly what Mr. Landau and Mr. Fay properly ask for.

MR. SWEET: We are very much more interested in physical properties than in the chemical composition.

MR. POPE: I think the committee has worked so hard and so long on this steel analysis that I feel if we talked here for several weeks we wouldn't come much nearer to a correct analysis and a correct number of specifications than we have got at present. With a large body, arguments along this line can last for an indefinite time, and no matter what changes are made, there can always be some objections. Personally I think that the specifications should be accepted as they are written and let the physical properties for each specification come along later.

MR. FURNESS: The reason is well known by the steel makers why we do not wish to have chemical composition and physical specifications coupled together. That is that he does not have supervision of the working and treatment of the steel in the users' place. [Mr. Furness seems to have overlooked the fact that the steel makers' guarantee of physical properties should be for steel as delivered by them—the heat treatment comes later.—Editor.]

MR. SOUTHER: I would like to second the motion of Mr. Pope for this reason: We have now spent the best part of a year on these specifications.

CHAIRMAN: All of you realize, of course, that in the motor-car industry we are progressing, and progressing very rapidly. It is not conceivable that we could adopt to-day a series of material specifications to which we would not care to make any amendment at the end of another year, or possibly even at the January meeting. We cannot stand still on a thing like this. We cannot say that we have the best steels to-day that we are going to have and we are not going to consider any further changes in specifications in a matter of this kind, because when a man comes to such a state of mind as that he becomes rather useless in the progress of the world. Therefore, I think that in discussing the motion which has been duly seconded and which is before the house that you bear in mind that any further changes and amendments that may be desired in these specifications will, of course, by the very nature of our organization and by the very nature of the progress which we are making, come up for discussion at subsequent meetings.

MR. NORRIS: I just want to say a couple of words. You state that there is a delay in referring this back. I want to call attention to the fact that I made the statement that these specifications are essentially the same—very few changes—practically none of any importance, since the ones that were adopted or passed on last January, so that there will be no delay—no inconvenience to any one—as these specifications as they stand to-day are practically no different from those we passed on in January.

CHAIRMAN: Let me call your attention to one matter in that connection, though, that perhaps might not be clear from what Mr. Norris has said. This is the first time that the report of this committee has come formally before the society to be passed upon for acceptance or rejection. The report as submitted previously has been for discussion only, and a good deal of this same discussion, of course, should have been brought out at the prior meeting, and I think that before this question is put to a vote that we ought to have some more discussion on it.

MR. BIRDSALL: It is well known that these specifications and heat treatments all have to be mixed with a certain amount of brains before we use them.

MR. DONALDSON: It seems to me that that will involve a modification of this report, and I hardly believe it would be fair to modify the report without having the committee have a chance to consider the modifications.

CHAIRMAN: Mr. Donaldson's remarks seem to meet with a good deal of favor. I think there is a possibility of making speed too rapidly in a matter of such seriousness as the one now before this house.

CHAIRMAN: There is a motion before the house that the report of the iron and steel sub-committee be accepted in its present form.

CHAIRMAN: The Chair will rule that this motion is before

the house as originally put. Will those in favor of this motion please say "Aye." Contrary, "No." The motion is carried.

(At this point of the discussion President Souther returned to the chair.)

PRESIDENT: The report, which is printed, is before you—of the Iron and Steel Committee. It seems to be the general desire that some suggestions be handed to the committee. The question is open for suggestions. I understand Mr. Tuthill would like to suggest that the cut be moved.

MR. POPE: That amendment was accepted.

PRESIDENT: That has already been disposed of—forget it. The next suggestion—that a method of sampling be adopted. Am I correct on that?

MR. KENNEY: I made that motion, sir. I think we should direct the point at which that is to be taken, or else provide that there shall be certain leeways, because it may be taken from any portion. Now, when the material goes out to the tester, he may take his drillings from almost any point. If he takes them from the extreme outside they will be too low, and if he takes them from the inside they will be very high. I think there ought to be some method specified by which they won't take them from either extreme.

PRESIDENT: Would you object to referring that back to the committee?

MR. KENNEY: No. I think that is the desirable thing to do.

PRESIDENT: I suggest that, because it is a question, that when thought of and studied in all its aspects, is not an easy one, and I think that we really will get at it better that way. There will be a paragraph relating to sampling and stating that any bars under a certain diameter will be sampled in a given way, and that the method of sampling a very thin sheet is something else, and so on. Your motion is, then, as I understand, that the committee be instructed as to sampling.

The motion was seconded.

PRESIDENT: Any remarks?

MR. FRANK: In that discussion of the committee's instructions, would it not be well—there are lots of engineers who don't get the material in bulk—if they could incorporate in those instructions some methods whereby it would be acceptable to the steel makers, so that they could get a fair test of that forging as it comes to the factory? I think it would be a great help to the majority of engineers.

PRESIDENT: I think that would be duly considered by the committee. We must consider every form of material produced.

MR. NORRIS: I make a motion that that letter of May 16 be referred to the Committee on Iron and Steel for consideration.

Motion was seconded and carried.

PRESIDENT: The next business before us is the report of the Aluminum and Copper Alloys Division.

MR. GILLETTE: The report, as it stands, was thoroughly discussed by the committee before the last general meeting of the society, and since then several suggestions have been brought up by Mr. Barr by letter, and as I understand it, the report as it stands before you is the final judgment of all the members of the committee, and we submit it for your approval or rejection.

PRESIDENT: Any further remarks on this report? I think it has received the most careful scrutiny of those best equipped, as consumer and producer. It has been most thoroughly discussed. It is moved and seconded that the report be adopted as printed.

MR. POPE: I would like to make a motion that the recommendations be referred back to the committee.

The motion was seconded.

PRESIDENT: Moved and seconded that the written criticisms or suggestions be referred back to the committee. Carried.

PRESIDENT: The next report is that of the Seamless Steel Tubes Division. Mr. Alden, the chairman of that committee, on account of illness in the family, cannot be present.

MR. HUSSEY: I make a motion that that be referred back to the committee on the ground that they can handle it and report it to the society in general. It covers too many little details and too many sizes to be taken.

MR. TUTHILL: As a member of that committee I rather object to our committee working any longer upon this report. We have pretty thoroughly hashed the matter up and we have only given you 150 sizes. Now, you don't need to have that cut down any less than that. We don't want to do any more work upon it.

MR. FOLJAMBE: I move that the report of the committee be adopted as it stands.

MR. HUSSEY: I second the motion.

PRESIDENT: It is moved and seconded that the report be accepted as printed. All those in favor signify by saying "Aye." Opposed. It is a vote.

MR. COFFIN: Isn't it true that all of the tube mill lists run on a diagonal across the sheet? Aren't there really only about 150 sizes here in actual practice?

PRESIDENT: That would be the more accurate statement, and yet they do appear, but they are not in common use.

The next report is that of the Nomenclature Division.

MR. SCHAEFFERS: It was referred yesterday back to the committee. This was referred back to the committee yesterday at the meeting of the Standards Committee.

PRESIDENT: Mr. Schaeffers reports that that committee has not finished its labors, and the Standards Committee referred it back to the sub-division. Wherefore that does not need to be disposed of at this meeting.

Mr. Entz presented a paper on the question of Long versus Short-Stroke Gasoline Engines.

PRESIDENT: I presume, judging by experience of other locations in which this subject has arisen, that there will be some discussion. It will be very welcome at this time. We have here to-day Mr. Clayden, one of the prominent automobile engineers of England.

MR. ARTHUR LUDLOW CLAYDEN, editor *The Automobile Engineer,* London, England: The first point I should like to mention is at the second paragraph in the interesting paper we just heard. That is to say, "The piston in the long stroke is lighter, being less in head and wall, but the speed being higher the balance of the two engines at the same revolutions per minute will probably not differ much." Well, now, I don't think that is

"Rubberneck" wagons carried their quota of members to the Automobile Country Club

quite so, because the balance there is more or less as the square of the speed and not directly as the speed, and I know one of the practical difficulties with the long stroke engine is that it runs hard. That is to say, the vibration is very considerable, when you are getting about the same power that you would out of the larger engine of the lower speed. That is to say, that a four and a half engine, giving 40 horsepower, runs without any considerable vibration, but a three and a quarter engine, which is a favorite size, gives considerable vibration at that speed, and it is that which has caused manufacturers in England to give enormous attention to the weight of the piston rods. It is quite usual to find pistons of three and a sixteenth engines, which weigh complete very little over a pound. Everybody who is making the 15 horsepower cars has an ambition of piston weight of about three-quarters of a pound, complete, simply and solely to get the smooth running—not to obtain still higher speeds. I think that so far as English work is concerned the average stroke is going to be about 1.5. Certainly I don't think we shall make any more square engines, and I believe this because it is found possible to get the same amount of power with a lighter engine and an engine that is cheaper. Of course, there were troubles with long stroke engines—particularly lubrication troubles. It struck me very curiously finding such a number of short stroke engines here, particularly on account of the note of the exhaust—the sound of the engines is certainly different to what it has become at home, and I rather fancy the engines must be rather heavier than those which we are using in England now—and of course the same of the popular French cars. At the same time I realize that the road conditions of the two countries differ widely. And of course the taxation has some influence on it, but not to a great extent, because the long stroke engine was coming along long before the taxation was being passed on the dimensions; also it was disappearing on the Continent. At first, in common with very many people in England, I thought the long stroke engine would be a nasty engine; that is to say, a hard engine to drive behind, and that the engine of possibly five-inch stroke would be the ultimate type. Now I certainly don't think so, and I think we shall end up by using a 3 1-4 inch cylinder bore and probably a 5 1-2 or even 6 1-2 inch stroke, and that will give just as smooth an engine and an engine that will be lighter. The advantage of lightness is obvious. Doubtless it is greater here or in England or anywhere where the roads are first class roads.

PRESIDENT: Remarks of the character made by Mr. Clayden are very much appreciated by all. It is another point of view. I think you will find the people over here always ready for that.

MR. LANDAU: I would like to ask Mr. Clayden if the engines—particularly the pistons—are made of brass, steel or forged steel?

MR. CLAYDEN: Malleable iron is what is coming to be the favorite material—malleable cast iron.

MR. LANDAU: I would like to ask a question of Mr. Entz. In speaking of two different sizes of engines, he apparently neglects the question of stroke in consideration of the valve design. It would seem to me, if I were designing a 4 1-2 x 4 1-2, I wouldn't use the same size valve unless the piston was the same. In that case the two valves might be different. I haven't figured out. If so, then the condition that he obtains from the speeds doesn't hold in accordance with the piston displacement; rather the relative portions of bore. In other words, the valve of 4 x 5 3-4 may be bigger than the 4 1-2 x 4 1-2.

MR. ENTZ: The volume of the two engines is equal; the 4 1-2 x 4 1-2 is exactly the same volume as the 4 x 5 3-4. The comparison is also made by the same speed. It has been customary for designers to make their valves a certain percentage of their cylinder bore, and therefore I have assumed in this case that the engine is designed in that way. If the valve chamber, however, were made identical in each case so that the speed from the valve would be the same in each case the compression space in the long stroke would still be less, even with the valve chamber of the same size and the valve the same size; in each case the volumetric efficiency would be the same. As far as the balance of the engine goes—the revolutions per minute should be the same in each case. The square of the speed doesn't enter into the consideration. In one case the piston head has 25 per cent. less area than in the other; if the length of the piston would be made in proportion—and the unbalanced force is a question not only of the weight of the piston, but directly as the linear speed—the balance would be the same.

PRESIDENT: Any further discussion?

MR. TRASK: I would like to ask those present if there is any perceptible difference in the balance of the motor in lengthening the stroke of the motor.

PRESIDENT: Mr. Entz, do you care to take that up?

MR. ENTZ: I think I covered that. In proportion to the stroke of a given number of revolutions per minute the stroke increases and the linear speed increases.

MR. COFFIN: I believe that this is the second paper that we have had on the long versus short stroke gas engine, and in those papers we see occasionally such words as "probably" and other terms of uncertainty. I know that I for one would like to see a paper on this subject expressed in actual figures, carried to the necessary number of decimal points, so that we may know and will not have to say "probably." I understand that one of our members was going to build two engines—single cylinder—both of 4 inch, and one of square proportion, as I remember it; the other with a long stroke; and I believe that it was the expression of that member that he would expect to find the highest efficiency in the short stroke motors.

MR. PERRIN: I find that, for instance: We designed first a square motor, and we got a certain amount of speed out of it, on the track. And we increased the stroke of that and by changing the gear ratio got as much speed on the track with the short-stroke as you could with the long-stroke motor; that is, equal adjustment. But the longer stroke motor makes the more roadable engine; that is, for touring; it goes better on the road. So that in our horsepower test it shows that with the proper proportionate speed that you will get as much horsepower with short stroke as with long stroke, but it gave a better engine for touring with the long stroke. That was the result.

PRESIDENT: Mr. Perrin, you referred to long and short; will you state what you mean by long?

MR. PERRIN: Five and three-eighths bore square and the clear stroke in the first place. We increased that to 6 inches. That wouldn't be called a long stroke, as we speak of long strokes now. It was 5 3-8 square, and then 5 3-8 x 6.

MR. WHITMAN: Mr. A. J. White is here, and he is a builder of engines; we would be interested in his views on the subject.

MR. A. J. WHITE: In addressing you, I would rather not go into this discussion. But we have recently lengthened our strokes considerably and with rather extraordinary results. We find that the longer stroke engine is much more efficient. It gives very much greater power. Now, in a concrete case: Last season we were doing a little track racing and with an engine of 90 bore, 110 stroke, we got a speed of about 84 miles an hour. And this season with an engine of 80 bore, 130 stroke, we have been doing 86, and I do not doubt that we shall reach 90 without any addition to the engine. It is very important, for the design of the valves is a matter which is an exceedingly important one, and I don't see—I think the only sane method of getting at the valves is the speed and the gases through the valves—the inlet and exit. Of course, on all racing engines it is very difficult to take an engine, say of 80 bore and 90 stroke, to compare with an engine of 80 bore and 130 stroke, because the 130 stroke is a much later engine, but at the same time we have been building now for fire engine work. We recently had a concrete case there, to deliver quite a number of engines of 110 mm. bore and we have been making all 130 stroke take this cylinder for pumping work. We found that we could just get the pressures that were required. Now we put another inch on to the stroke of that engine, and the engine absolutely played with the work.

PRESIDENT: Is Mr. Ferguson here?

MR. FERGUSON: Well, last year we made a six-cylinder of 5 1-4 bore by 5 1-2 stroke, and the horsepower we got was, at 1,000 revolutions per minute, 73. For 1912 we are making a six-cylinder engine, 5-inch bore by 7-inch stroke, that gives 89 horsepower, at 1,000 revolutions per minute. Under the same testing conditions, that was 73 and this 90. Of course you have got to take the revolutions per minute per thousand feet piston speed. The 5 1-2 stroke was practically 1,100 revolutions per minute. That gives 80 horsepower. As to the 7-inch stroke, I haven't got here just what revolutions per minute that is for 1,000 feet per minute. You know it is a similar number, and we have kept the car in the same gear so that the 5 x 7 is a more powerful proposition than the 5 1-4 x 5 1-2.

PRESIDENT: The question of balance and troubles of that kind and lubrication?

MR. FERGUSON: I think most of the strokes they have talked about are not long. The old proportion that we used was 4 x 5. We are not talking about long-stroke engines. They are simply increasing the proportion by finding the decimal relations and yet you say some got good results if you keep double the bore.

PRESIDENT: Mr. Sweet, do you care to say anything about that? What ratio has your company developed?

MR. SWEET: No, I haven't anything to say.

MR. H. L. HORNING: The question is up to us engine builders. While we haven't accomplished much, our method of going after it may be interesting to the engineer, and it is becoming more interesting to us. On examining the records of the society and a number of papers by engineers, we came to the conclusion that there was a certain speed at which nearly all motors of various ratios gave the maximum economy; there was also a speed at which the torque seemed to be best. The question came up to determine for this truck motor what was the speed of that motor in the truck, and we found that the speed which would correspond with about 950 speed was the correct one, and that therefore a stroke of 6 3-4 was about as close—that would cover not only a bore of 5 inches, but bores running down to 5 inches. This thing particularly refers to commercial uses. The question as to balances that a number of gentlemen speak of, of course, is a serious one in using a long stroke, and the weight of the connecting rod and the piston is a serious one. Therefore, as motor makers, we are working it out, and I am sorry not to be able to give you results. We have adopted a stroke of 6 3-4 because that stroke represented a piston speed of 900 feet per minute—the economical speed, and a speed which is ordinarily used. And after that we intend to use on this engine the various size bores; the smaller engine being a 4, and the larger of 4 3-4. Therefore we can give a man a motor for small size work or one for a larger size.

PRESIDENT: It is considered wise that the report of the Wheel Dimensions and Fastenings for Tires Division be heard. Would Mr. Kennedy please present the report. It was acted upon yesterday by the standards committee and approved. (Here Mr. Kennedy read the report of the Wheel Dimensions and Fastenings for Tires Division, which was accepted.)

Discussion on "Administrative Engineering and Salesmanship"

PRESIDENT: You have heard the paper by Mr. Kennedy, and it is now before you for discussion.

MR. SLADE: At the last monthly meeting of the Metropolitan Section of the S. A. E. in New York, when an informal discussion was held on the subject of salesmanship and engineering, I was called upon to open the subject for discussion. I have read Mr. Kennedy's paper carefully and have made a few notes which I am glad to have the privilege of submitting for consideration. There are two points which I wish to present, not in opposition or destructive criticism of the paper, but in a measure supplementary to it.

I believe that those of us who have been connected with the successful introduction or installation of commercial motor vehicles during the past few years are prepared to agree absolutely with Mr. Kennedy's views as to co-operation between the executive, the commercial engineer and the freight automobile salesman.

Now, as to the two points which I want to bring out in this discussion. The first is this:

The paper seems to treat of what I may term "Original installations." By this I mean, where the customer is installing motor truck transportation to replace or supplement other transportation methods, as horses and wagons, railroad freight or express, water shipments, etc. In such cases the question is to a great extent the broad one of comparison of transportation methods in a general way, the motor truck being considered generally rather than specifically, whether the motor truck in general can supplant or supplement other methods of transportation with profit to the customer. In such cases, cultivating fresh soil, Mr. Kennedy's system should accomplish most satisfactory results.

But consider for a moment a somewhat different case, where the customer already uses motor trucks, but of a type or size, or having features of design and construction which have not resulted in that customer securing the benefits which a more suitable installation would give him; can he improve his truck installation by the use of more suitable vehicles? The salesman, the man on the firing line; he is the member of the organization who first comes into contact with that prospective customer. Will he be able to do his share of the work if he is equipped only with the limited technical knowledge and experience which this paper indicates as being necessary?

I believe not. Unless he is well informed as to the specific points of superiority or advantage which his product possesses over that already in the customer's service, he will not be able to pave the way for the commercial engineer and the executive to play their part in the transaction.

The point then is this: The commercial vehicle salesman must know his machines far more intimately than this paper requires, and in my opinion it would be very desirable for him to spend some period, varying in length in accordance with circumstances, in such of the departments of his factory where the necessary knowledge can be most quickly acquired.

The second point I want to call attention to is the relationship between the commercial engineer and the designing engineer. This was not mentioned in the paper. The designer of a motor truck must build to meet the actual business requirements of the lines of business to which the sales department will dispose of the product. Now, how can the designing engineer know what to produce unless there is the closest co-operation between him and the commercial engineer?

Team play in the motor truck business requires that these two members of the engineering force keep in close touch at all times. It seems unnecessary to elaborate this point before this audience as the many advantages of such co-operation appear perfectly obvious.

PRESIDENT: Mr. Donaldson, have you anything you care to say along this line?

MR. DONALDSON: The point to be borne in mind is whether a man wants to sell trucks or wants to sell transportation. If he is to make a success, he must sell transportation. If he is going to sell something, he has got to know something about it. If he is a salesman that knows a truck will carry a certain size load, or if he is simply a construction engineer that knows the type of carbureter used and why it is used, that won't get him very far. The plan that Mr. Kennedy proposes is the most sensible one in the light of our present experience. If you have an engineer in the field that is just as competent to consider the construction of the machine, Mr. Kennedy calls him the commercial engineer; we might name him the installation engineer. As a matter of fact, I believe one of the ultimate results in the progress of this work may be that the principal features of the design will be laid down by the installation engineer, and it will be up to the shop engineer to adopt the kind of construction that is applied to the features of the plan. The commercial engineer

may not be conversant with the methods in vogue in the shop, and by getting their co-operation, you will not only put out the right kind of vehicle, but you will be able to manufacture it economically. Of course, to those that have followed the truck business for a number of years, it seems absurd, the practice that is too widely followed of some one going out to sell the truck; he hasn't the remotest idea of why he wants to sell it except that he wants to get the money for it. If you are going to found a solid business on such a basis as that, it is very strange. The technical is lost sight of by the comparison between this field and the pleasure field. The situation is an entirely different one. The purposes of the car in many cases in the pleasure field are best known by the purchaser. In the case of the truck business, the purchaser knows absolutely nothing about it. He knows the machine will run, but of how they run to advantage for him he knows nothing whatever. If the man making the sale is neither competent himself nor is in touch with those that are competent and who can make an installation that will stick, the business has no real commercial foundation. The point, I think, in the discussion, that is an interesting one to the members of this society, is the very broad field that is rapidly growing for engineering ability in the truck business. I think too many engineers feel that their place is in the drafting office and in the shop; and as a matter of fact the engineer in the field, the installation engineer, can very often render much more effective service to his company than the man in the drafting room, who is simply a production engineer.

President: May we have a few words from Mr. Whitney?

Mr. E. R. Whitney: I have in our factory at the present time about ten men in hand along the lines suggested by Mr. Donaldson. Some of them are graduates of technical colleges We have one Cornell man; we have three or four graduates of the University of Pennsylvania, and so on. These men are working in overalls. They start in the paint shop. They learn how to mix paint. They learn why certain kinds of varnish and fillers are used. They go to the wood shop, the machine shop, the repair shop and wind up on the demonstrating force.

The time is past when you can go out and sell trucks on a line of talk. The buying public is too wise. It is surprising the kind of questions that will be thrown at you, and it is surprising the amount of knowledge that the people who are buying and using trucks have of the trucks themselves. A great many of them are owners of pleasure cars and you have got to get down and talk sense to them. The more engineering a salesman has the farther he can get. The factory engineer cannot jump and run on to the call of half a dozen salesmen who may be scattered all over the country.

President: Mr. Whitney made one remark that appeals to me very strongly: Put your men into the repair shop to learn. My pet hobby is that one learns by mistakes, and that is where mistakes show up. If a problem be handed to me for solution, I go find a repair shop; that is where I head for; and there I can see where the mistakes are.

Mr. Birdsall: I can only say that I agree with Mr. Kennedy's paper. It has always been a theory of mine that the salesman should be a technical or a semi-technical man. I think it is absolutely necessary that the salesman should be familiar with the simple mechanical construction of the truck, and with transportation problems. The salesman has got to be able to answer all questions. I know in the big department stores in New York City that we have had some little experience with new trucks and transportation problems. Those people are very keen and they have got data on the cost of transportation, and if the salesman is not up on the subject he has a very slight chance of selling any trucks to those people.

President: We have heard from various sides on this question. I would like to get an expression of opinion from those interested and who have actually produced trucks.

Mr. Comner: Perhaps on this line of engineering transportation for concerns, we have had some little experience and that duty has rather devolved upon me in the last six months to investigate transportation conditions and analyze them and advise with the merchant as to the proper car and the proper capacity and proper method of handling them. I do find, however, a great objection on the part of the heads of the transportation departments as to adopting the new method. It is revolutionary. Their routes have got to be changed; their hours have got to be changed and everything is turned upside down to their minds. After we get a new installation on a few routes, they see the difference and it becomes easy to put in a new equipment. The close co-operation of the commercial engineer's department, as taken from a user's standpoint, and the engineers in the drafting room, or producing engineers, is one of the most important functions that is to be performed in the manufacture of trucks. It is only by the experience of the user that we can learn to improve, and the closer that we stand in with the user, with his mechanical force, the sooner we can solve the problem of getting a more perfect machine to offer the public.

Mr. Graham: In my present position I have come in contact with the engineers in the factories, and the engineers in the truck line as well as in the pleasure car.

In going about from city to city, I have discovered these conditions to exist: The truck that will be perfectly satisfactory in New York City or in Boston might prove a total failure in Cincinnati or Pittsburg. The designing engineer, as he makes his original design, has perhaps been located in Detroit or the middle west, where the country is level. He has not taken into account the hills, and condition of paving, or say in the city of Cincinnati, where it is necessary to go to wharves or railroads where the streets are not always level; and the fact that he has not taken these conditions into account has given him a design or he has produced a design, which is not satisfactory for all conditions that exist in different cities. As an illustration of that, the cab that we used in New York City was a foreign make. It was designed for the European cities and European roads. In New York City with our rough paving, in many ways it became the subject of further designing effort.

It seems to me that this paper has opened the field for the right sort of co-operation between the selling and the production engineering end of the business which cannot help but produce good results, and I think as we think over this problem which has been presented that we will find a good many ways in which the commercial engineer can be of assistance, and I think another thing will develop, and that is that a good many of our engineers who are to-day only perhaps partially successful as designing engineers would be eminently successful as commercial engineers.

Mr. Moskovics: It seems to me that the most important commercial function is a trifle overlooked. That is, keeping the truck sold.

Mr. Landau: It seems to me that the point brought out by Mr. Moskovics in regard to keeping the vehicles sold is really another phase of this problem, which is the so-called service department, which has been installed by several of the truck makers, and the work of the commercial engineer has nothing to do with the service department which keeps the thing in shape.

Mr. Firestone: Our experience has been very limited on trucks, but Mr. Kennedy's paper has some very good points to it. The commercial engineer, I take it, ought to sell to the purchaser that which he wants; not *a* truck, but the truck that will fill the bill. I think that will go farther toward keeping the truck sold than just selling him a truck. Find out what his requirements are, and that requires a commercial engineer. We need more commercial engineers; men who will tell us what is demanded from the user of trucks.

Mr. Kennedy: I would like to comment a little on the remarks of Mr. Slade. I want to bring out the reason why it is not so very desirable to have the salesmen completely conversant with the technicalities of the machine. One of the reasons is that the salesman who has been given technical information generally runs off at a tangent. After a while he learns of the differences between the competitor's machine and his own,

and he becomes rather impressed with the superiority of the competitor's machine and says: "If you would only put on such a device or such a lever, I could sell the machine." And just as soon as the salesman is able to converse on the technicalities of the equipment, he begins to antagonize his competitor, to bring up a comparison between his own machine and his competitor's machine and instead of breeding confidence in the mind of the purchaser, he rather instills into the prospective purchaser's mind that the automobile business is not yet stable.

In regard to selling additional machines where the equipment has first been put in. There is a case where the engineer ought to supplement the efforts of the salesman, and it is my idea that the engineer ought to co-operate with the salesman in such cases. There is nothing new in handling the business in the manner I suggest.

However, I don't mean to say that the sales engineer can act altogether in the capacity of salesman in the truck business. I think it requires a good deal of tact and salesmanship to be able to approach the consumers and get into their confidence. The engineer is too conscious; he is a man that is filled with a great many details, and the development of his mental capacity is a hindrance in getting into the organization where the stuff should be sold and being able to make a favorable impression upon the prospective purchaser. The salesman ought to be used in the truck field simply as an auxiliary to the administration instead of depending upon the salesman in the truck field as he is depended upon in the pleasure field.

With regard to the influence of the commercial engineer on the designing engineer, I may say, where the point has been brought out, most of the trucks are designed in isolated locations. They may be designed in a large place like Detroit or Cleveland, but the majority of them are designed in small towns where the engineer seldom comes in contact with the majority of conditions that have to be contended with in the operation of vehicles.

Most of the people with whom I have discussed this subject who are at the head of large administrations are of the opinion that it is not very good practice to have a chief engineer at the factory, since the chief engineer's function seems to be to continually invent. These men are commercial men; they put a certain amount of money into trucks and they want to see a return. The chief engineer at the factory, besides the standards, designs machines that are so radical as to interfere with the purpose of making money, and the real way seems to be to bring the critical information into the organization by means of the salesman and commercial engineer, and that the designing then ought to be done upon the conference method.

Another advantage that this proposed system has, that if there is any inefficiency elsewhere in the organization, the efficiency likely to develop from the system proposed in the sales department is bound to bring out the inefficiency that may exist elsewhere. Most of the truck manufacturers are at present interested in the sale of quantity machines. That is the truck they need in their business.

It is in the large business that they can make the most money. They can afford to sell installations at very much less than the list price. The income from a quantity sale is very much greater than the same amount of trucks sold in a retail manner. The advantage of quantity installations is that the manufacturer is better protected in quantity installation than he is in a retail sale, because usually more time is given to the proper operation of vehicles and the vehicles are operated under some intelligent direction and under conditions known to the manufacturer.

Besides, that will very largely bring out any defects that exist in the trucks, and consequently the efficiency of the sales organization will develop any inefficiency that may exist; if there is any defect in the truck it is bound to appear.

Another important point is this: That by making the administration directly responsible for the sales, the salesman is relieved from the responsibility which is thrust upon him and which ought not to be placed under his direction, and usually under the existing conditions the administration largely depends upon the sales force to make good, and they never give it the same share of executive attention which they give the other departments of their business.

There is one more point that I want to bring out, which has been touched upon by Mr. Graham. That is, one of the purposes I had in bringing this paper before the meeting was to bring to the notice of the engineers the fact that there is another field, perhaps a far more profitable field, at the commercial end rather than the designing end. Usually in an organization the executive or commercial man is considered superior to the engineer, although the engineer has devoted his entire life to his study. Yet in a small organization the business executive will get five thousand and the engineer will get three. The nearer the engineer can get to the business end of the organization, the more profitable it will be to him.

Mr. Clayden: I notice here that there is nothing corresponding to the steam wagon, which is the most desirable vehicle for heavy work in England. I think I am right in saying that for loads of five tons, in the neighborhood of five tons, the steam wagon is so much more popular than the gasoline vehicle that that hardly amounts to anything over there.

Lock Washer Recommendation Adopted

The following recommendations of the Lock Washer Division were adopted as the final form of specification by the Society:

We recommend lock washers of such dimensions that the outside diameters of washers shall practically coincide with the long diameters of A. L. A. M. standard nuts, which are approximately the short diameters of U. S. standard nuts.

Inside diameters of washers shall be from 1-64" to 1-32" larger than bolt diameters.

Complete dimensions as follows:

Bolt dia.	Lock Wash. Sec.	Bolt dia.	Lock Wash. Sec.
3-16"	1-16" x 1-16"	11-16"	1-4" x 1-4"
1-4	5-64 x 5-64	3-4	1-4 x 1-4
5-16	1-8 x 1-8	7-8	17-64 x 17-64
3-8	1-8 x 1-8	1"	5-16 x 5-16
7-16	11-64 x 11-64	1 1-8	5-16 x 5-16
1-8	11-64 x 11-64	1 1-4	3-8 x 3-8
9-16	13-64 x 13-64	1 3-8	3-8 x 3-8
5-8	13-64 x 13-64	1 1-2	7-16 x 7-16

Test: *Temper*—After compression to flat, reaction shall be sufficient to indicate necessary spring power, and on a subsequent compression to flat shall manifest no appreciable loss in reaction.

Toughness—45 per cent. of the lock washer, including one end, shall be firmly secured in a vise, and 45 degrees, including the other end, shall be firmly secured between parallel jaws of a wrench. Movement of wrench at right angles to helical curve shall twist washer through 45 degrees without sign of fracture, and shall twist washer entirely apart within 135 degrees.

As this test destroys the product, a few from a package shall determine the character of the remainder.

Amendments to Lock Washer Specifications—As a number of the engineers regarded the sections adopted as correct where washers were to be used against iron or steel, but were too heavy, where washers were to be used against soft metal, the following specifications were added to the original as First Amendment:

Amendment No. 1:

Bolt dia.	Lock Wash. Sec.	Bolt dia.	Lock Wash. Sec.
3-16"	1-16" x 3-64"	9-16"	13-64" x 5-32"
1-4	5-64 x 1-16	5-8	13-64 x 5-32
5-16	1-8 x 3-32	11-16	1-4 x 3-16
3-8	1-8 x 3-32	3-4	1-4 x 3-16
7-16	11-64 x 1-8	7-8	17-64 x 3-16
1-2	11-64 x 1-8	1"	5-16 x 1-4

Amendment No. 2—All lock washers shall be parallel faced sections and bulging or malformed ends must be avoided.

(*Continued on page* 1411.)

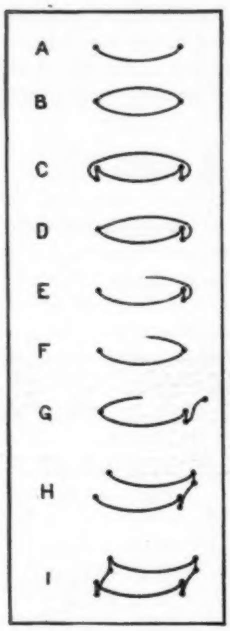
Report of Springs Division

Recommendation of the Springs Division of the Standards Committee of the Society of Automobile Engineers, as of date of June, 1911. Besides a set of standard specifications in ordering springs, the nomenclature of the subject is illustrated in a series of line drawings.

IT was decided to submit the recommendations below given as the first report of the Springs Division. The information collected on the forms sent the S. A. E. members includes too much material to be handled at this time.

We here refer to nomenclature, follow with suggestions as to ordering, and conclude with subjects that we consider should receive immediate attention.

NOMENCLATURE



A—Half elliptic.

B—Elliptic; consists of: Top half, elliptic; bottom half, elliptic. Joined at ends by bolts.

C—Scroll elliptic; consists of: Top half, scroll; bottom half, elliptic. Joined at ends by shackles.

D—Scroll elliptic (one end); consists of: Top half, scroll (one end); bottom half, elliptic. Joined at one end by bolt, at the other by shackle.

E—Three-quarter scroll elliptic; consists of: Upper quarter, scroll, bottom, half elliptic. Joined at one end by shackle.

F—Three-quarter elliptic; consists of: Upper quarter, elliptic; lower half, elliptic. Joined at both ends by bolts.

G—Three-quarter coach; consists of: Upper quarter, elliptic; lower half, elliptic and transverse spring. Joined at one end by bolt and to the transverse spring by shackles. Transverse meaning parallel to axle.

H—Three-point suspension; consists of: Two side members, half elliptic, parallel to frame and half-elliptic transverse spring. Joined to transverse spring by shackles.

I—Four-point suspension; consists of: Two side members, half elliptic, parallel to frame, and two half-elliptic transverse springs. Joined to transverse springs by shackles.

RECOMMENDATIONS FOR ORDERING SPRINGS

A—Give type of springs desired. Exercise great care to select types suited for purposes to which put.

B—Specify material.

C—Specify width of spring either by 000 or 1/4".

Standard Sizes

NOTE—Pleasure cars—1 1/4", 1 1/2", 1 3/4", 2", 2 1/4", 2 1/2", 3".

Commercial cars—2", 2 1/4", 2 1/2", 3", 3 1/2", 4", 4 1/2".

D—Number of leaves in gauge to be left to the spring-maker.

E—Specify length in the following manner:

On half elliptic give offset, stating length on both ends on straight line between holes in brackets. This should be given on all half elliptics.

On elliptics, length center to center of eyes under full passenger of merchandise load.

On full scroll, length center to center of eyes of lower half elliptic under full passenger or merchandise load.

On three-quarter scroll, bottom half, give distance on straight line from hole of front bracket rear spring to point on frame vertical to rear axle. Top quarter distance on straight line from center hole in bracket holding upper quarter, to point vertical to rear eye of quarter under load.

Shackles connecting bottom half to upper quarter must be vertical under load; spring seat on axle and on bracket holding upper quarter parallel under full load and parallel to floor line.

Transverse spring, same length as half elliptic.

Give length center to center of side member spring seat on three-point suspension and on other types, center of holes in fixed bracket to which shackles are connected.

Three-point suspension, give distance on horizontal line parallel to frame between center of hole on front bracket rear spring and center of bracket supported by rear spring.

Give overall opening under load of car, with and without passengers. Opening on half elliptic to be from straight line through center of eyes to short leaf inclusive.

On three-quarter scroll, give distance from spring seat to spring seat or bracket holding upper quarter.

Do not give depth of scroll.

Give clearance under load with passengers, in front of two nearest striking points and position relative to rear axle.

Give center of load front relative to front axle.

Give center of load rear relative to rear axle.

State whether spring takes driving.

Give number of passengers.

On trucks give merchandise load.

Give load with and without passengers on each spring (not pairs).

With three-point suspension in rear give weight on total platform.

Flexibility

Give average deflection per 100 pounds.

Features to be Left to Spring-maker

Eye up or down, in or out.

Spacing of leaves.

Position of rebound clip, except on front springs to avoid contact with tire on other parts.

State whether shackles are under compression or tension and length of shackle used.

Bushings—Bronze or steel, 1/8" wall.

Eyes—Width of bar $\pm$ 0.005". One leaf to form eye on truck or pleasure car springs.

Nibs—If used, to be 3/8" diameter; 3/4" C to C where two are used. Head on center bolt of stud to be fillister style.

Center bolt sizes—*Recommended:

Pleasure cars—up to 2", 5/16" } 1/2" diameter head.
2 1/4" to 3", 3/8" } 1/2" high head.

Commercial cars—2", 5/16"; 5/8" diameter × 1/2" head.
2 1/4" to 2 1/2", 3/8"; 5/8" diameter × 1/2" head.
3" to 3 1/2", 7/16"; 3/4" diameter × 3/4" head.
4" to 4 1/2", 1/2"; 3/4" diameter × 1/2" head.

Oilers—Standard thread—1/8" pipe.*

Rebound clips—Recommended in all cases.

Limits—Bore of bushing 0 to + 0.005".
Bore of eye 0 to + 0.005".

Thread—A. L. A. M.

Nuts—Hex. or slab oval.

A. C. BERGMANN, Chairman.
CHRISTIAN GIRL,
W. H. SON,
E. K. ROWLAND,
A. C. SCHULZ,
R. L. MARGAN,
G. S. CASE,
Springs Division.

Report of Ball and Roller Bearings Division

Being the preliminary report (for discussion only) of the Ball and Roller Bearings Division of the Standards Committee of the Society of Automobile Engineers, as of date of January 11, 1911.

BALL BEARINGS—The sizes adopted by the annular ball-bearing producers shall be recognized as standard for ball bearings as to bore, outside diameter and width. An official table (Ball Bearings Standards A) is given below.

*There has been some difference of opinion on these items, and discussion on them is particularly requested.

SHORT TYPE ROLLER BEARINGS—For short type roller bearings, whether plain or tapered, the same sizes of bore and outside diameter as for annular ball bearings shall be standard.

LENGTH OF LONG BALL AND ROLLER BEARINGS—No effort is considered advisable at the present time to standardize the length of the so-called long ball or roller bearings.

BALL BEARINGS STANDARD OF CAPACITY—The standard of capacity of ball bearings shall be as given in the table "Ball Bearings Standards A."

OUTSIDE AND INSIDE CORNERS—The corners at the bore of the inner race shall correspond to the dimensions given in the attached official table (Ball Bearings Standards A). The corners of the outside race shall be rounded or chamfered not less than 0.04 in.

*STANDARD OF CAPACITY—Attention is called to the fact that the capacities given in the above tables are based upon ball bearings manufactured of suitable workmanship and of suitable material and running at uniform speed and uniform radial load, not exceeding 500 revolutions per minute.

It is further suggested in explanation of the load standards

BALL BEARINGS STANDARD A

LIGHT SERIES

No. of Bearing.	Bore		Diameter		Width		Corner at bore of inner race		Radial Load in Lbs.
	Mm.	Inches	Mm.	Inches.	Mm.	Inches	Mm.	Inches	
200	10	0.39370	30	1.18110	9	0.35433	1	0.04	120
201	12	0.47244	32	1.25984	10	0.39370	1	0.04	140
202	15	0.59055	35	1.37795	11	0.43307	1	0.04	160
203	17	0.66939	40	1.57481	12	0.47244	1	0.04	250
204	20	0.78740	47	1.85040	14	0.55118	1	0.04	320
205	25	0.98425	52	2.04735	15	0.59055	1	0.04	350
206	30	1.18110	62	2.44095	16	0.62992	1	0.04	550
207	35	1.37795	72	2.83465	17	0.66929	1	0.04	600
208	40	1.57481	80	3.14962	18	0.70866	2	0.08	860
209	45	1.77166	85	3.34647	19	0.74803	2	0.08	950
210	50	1.96851	90	3.54332	20	0.78740	2	0.08	1000
211	55	2.16536	100	3.93702	21	0.82677	2	0.08	1160
212	60	2.36221	110	4.33072	22	0.86614	2	0.08	1550
213	65	2.55906	120	4.72443	23	0.90551	2	0.08	1670
214	70	2.75591	125	4.92128	24	0.94488	2	0.08	1820
215	75	2.95277	130	5.11813	25	0.98425	2	0.08	2130
216	80	3.14962	140	5.51183	26	1.02362	3	0.12	2650
217	85	3.34647	150	5.90554	28	1.10236	3	0.12	2850
218	90	3.54332	160	6.29924	30	1.18110	3	0.12	3400
219	95	3.74017	170	6.69294	32	1.25984	3	0.12	3750
220	100	3.93702	180	7.08664	34	1.33858	3	0.12	3950
221	105	4.13387	190	7.48035	36	1.41732	3	0.12	4600
222	110	4.33072	200	7.87405	38	1.49607	3	0.12	5000

BALL BEARINGS STANDARD A

MEDIUM SERIES

No. of Bearing.	Bore		Diameter		Width		Corner at bore of inner race		Radial Load in Lbs.
	Mm.	Inches	Mm.	Inches.	Mm.	Inches	Mm.	Inches	
300	10	0.39370	35	1.37795	11	0.43307	1	0.04	200
301	12	0.47244	37	1.45669	12	0.47244	1	0.04	240
302	15	0.59055	42	1.65355	13	0.51181	1	0.04	280
303	17	0.66929	47	1.85040	14	0.55118	1	0.04	370
304	20	0.78740	52	2.04725	15	0.59055	1	0.04	440
305	25	0.98425	62	2.44195	17	0.66929	1	0.04	620
306	30	1.18110	72	2.83465	19	0.74803	2	0.08	860
307	35	1.37795	80	3.14962	21	0.82677	2	0.08	1100
308	40	1.57481	90	3.54332	23	0.90551	2	0.08	1450
309	45	1.77166	100	3.93702	25	0.98425	2	0.08	1750
310	50	1.96851	110	4.33072	27	1.06299	2	0.08	2100
311	55	2.16536	120	4.72443	29	1.14173	2	0.08	2400
312	60	2.36221	130	5.11813	31	1.22047	2	0.08	2800
313	65	2.55906	140	5.51183	33	1.29921	3	0.12	3300
314	70	2.75591	150	5.90554	35	1.37795	3	0.12	4000
315	75	2.95277	160	6.29924	37	1.45669	3	0.12	4400
316	80	3.14962	170	6.69294	39	1.53544	3	0.12	5000
317	85	3.34647	180	7.08664	41	1.61418	3	0.12	5700
318	90	3.54332	190	7.48035	43	1.69292	3	0.12	6400
319	95	3.74017	200	7.87405	45	1.77166	3	0.12	7000
320	100	3.93702	215	8.46460	47	1.85040	3	0.12	7700
321	105	4.13387	225	8.85830	49	1.92914	3	0.12	8400
322	110	4.33072	240	9.44886	50	1.96851	3	0.12	10000

BALL BEARINGS STANDARD A

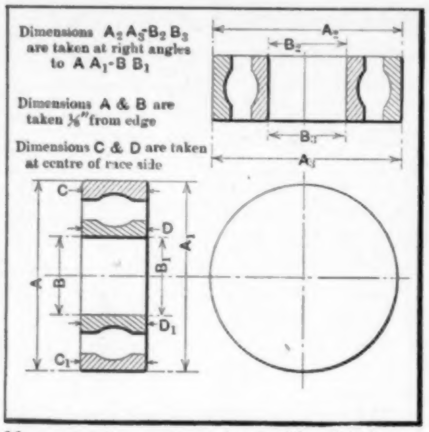
HEAVY SERIES

No. of Bearing.	Bore		Diameter		Width		Corner at bore of inner race		Radial Load in Lbs.
	Mm.	Inches	Mm.	Inches.	Mm.	Inches	Mm.	Inches	
403	17	0.66929	62	2.44095	17	0.66929	1	0.04	850
404	20	0.78740	72	2.83465	19	0.74803	2	0.08	1050
405	25	0.98425	80	3.14962	21	0.82677	2	0.08	1320
406	30	1.18110	90	3.54332	23	0.90551	2	0.08	1600
407	35	1.37799	100	3.93702	25	0.98425	2	0.08	1900
408	40	1.57481	110	4.33072	27	1.06299	2	0.08	2200
409	45	1.77160	120	4.72443	29	1.14173	2	0.08	2500
410	50	1.96851	130	5.11813	31	1.22047	2	0.08	3400
411	55	2.16536	140	5.51183	33	1.29921	3	0.12	3900
412	60	2.36221	150	5.90554	35	1.37795	3	0.12	4400
413	65	2.55906	160	6.29924	37	1.45669	3	0.12	4900
414	70	2.75591	180	7.08664	42	1.65355	3	0.12	6200
415	75	2.95277	190	7.48035	45	1.77160	3	0.12	6600
416	80	3.14962	200	7.87405	48	1.88977	3	0.12	7300
417	85	3.34647	210	8.26775	52	2.04725	3	0.12	8580
418	90	3.54332	225	8.85830	54	2.12599	3	0.12	10000
419	95	3.74017	250	9.84256	55	2.16536	3	0.12	11880
420	100	3.93702	265	10.43311	60	2.36221	3	0.12	14000

that it cannot be expected that all conditions will be covered by the loads given. For conditions of shock, axial thrust, and

LIMITS OF TOLERANCE, CHANGING ACCORDING TO SIZE, ADVOCATED BY SEVERAL MAKERS OF BALL BEARINGS

Outer Race Diameter	S. A. E. Jan. 1911			Hess Bright			Timken			Fafnir W. Hasselkus			S. K. F. Co. F. H. Poor			Standard Roller Bearing Co. H. M. Hanks			Recommended by Users Warner Gear Co. C. E. Davis			Rhineland S. R. Shepard		
Bearing No.	Plus Limit	Minus Limit	Total Limit	Plus	Minus	Total	Plus	Minus	Total	Plus	Minus	Total	Plus	Minus	Total	Plus	Minus	Tot al	Plus	Minus	Total	Plus	Minus	Total
200–204 inc. 300–303	.0005	.0005	.001	0	.0006	.0006	.001	0	.001	.0002	.0002	.0004	0	.0008	.0008	.0001	.0001	.0002	0	.0003	.0003	0	.0004	.0004
205–216 304–313 403–411	.0005	.001	.0015	0	.0008	.0008	.001	0	.001	.0003	.0005	.0008	0	.0008	.0008	.0001	.0001	.0002	0	.0003	.0003	0	.0004	.0004
217–222 314–319 412–416	.0005	.0015	.002	0	.0012	.0012	.001		.001	.0005	.0010	.0015	0	.0012	.0012	.0001	.0001	.0002	0	.0003	.0003	0	.0004	.0004
BORE																								
200–204 300–302	.001	0	.001	.0002	.0004	.0006	.001	0	.001	.0003	.0002	.0005	.0002	.0004	.0006	.0001	.0001	.0002	0	.0005	.0005	.0002	.0004	.0006
205–216 304–313 403–411	.001	0	.001	.0002	.0004	.0006	.001	0	.001	.0003	.0003	.0006	.0002	.0004	.0006	.0001	.0001	.0002	0	.0005	.0005	.0002	.0004	.0006
217–222 314–319 412–416	.001	0	.001	.0002	.0004	.0006	.001	0	.001	.0003	.0003	.0006	.0002	.0004	.0006	.0001	.0001	.0002	0	.0005	.0005	.0002	.0004	.0006
WIDTH																								
200–204 300–302	0	.002	.002	0	.002	.002	2 ...	.....	.....	..0	.002	.002	...	.....	.....	..0	.002	.002	.....	.....	.....	.001	.001	.002
205–216 304–313 403–411	0	.004	.004	0	.002	.002	.....	.....	.....	0	.004	.004	.....	.....	.....	0	.002	.002	.....	.....	.....	.001	.001	.002
217–222 314–319 412–416	0	.006	.006	0	.002	.002	.....	.....	.....	0	.006	.006	.....	.....	.....	0	.002	.002	.....	.....	.....	.001	.001	.002



Measurements necessary in checking ball bearings

a combination of the two, greater factors of safety will have to be used.

TOLERANCE — The Division has received the statement appearing on the previous page of limits worked to by various bearing manufacturers, which are given in parallel with the limits mentioned in the first report of this Division.

Before making further recommendation as to tolerance in the measurements in question, it is the intention of the Division to have the measurements shown in the figure above, made by an authority.

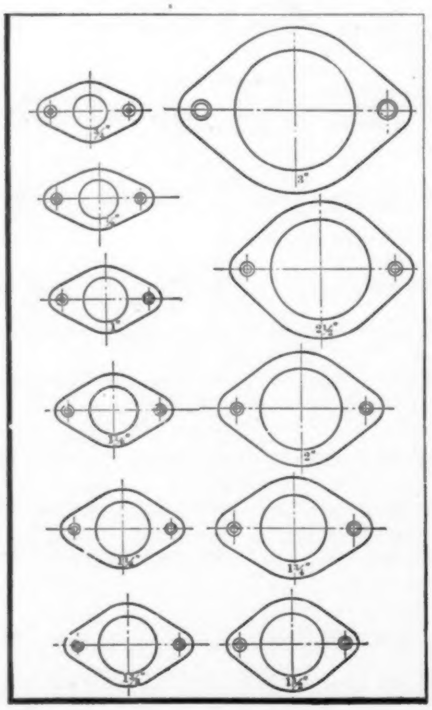
DAVID FERGUSON, Chairman.	A. P. SLOAN, JR.,
D. F. GRAHAM,	H. W. ALDEN,
W. P. KENNEDY,	HOWARD MARMON,
HENRY HESS,	V. E. LACY, JR.
A. L. RIKER,	*Ball and Roller Bearing Division.*

Report of the Carbureter Division

Being the recommendation of the Carbureter Division of the Standards Committee of the Society of Automobile Engineers, as of date of June, 1911, including a number of drawings of carbureter flanges and a tabulation of important dimensions.

FLANGES—The Carbureter Division herewith submits drawings showing carbureter flanges ranging from 3/4" to 3", and tabulation of important dimensions governing standardization.

The points involved have been carefully gone over, including consideration of the carbureter flange dimensions of principal carbureter manufacturers. We believe that the dimensions given on the drawings are well suited to be standard.



Suggestions for standard sizes of carbureter flanges

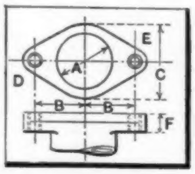
NOMINAL AND ACTUAL SIZES OF OPENINGS—In most instances the actual opening in the carbureter flange is 1/8" greater in diameter than the size by which the carbureter is known; for example, an inch carbureter has, as a rule, an opening 1 1/8" in diameter. Some manufacturers use openings which are 3/16" in excess of the nominal carbureter size. Therefore extreme cases have been taken and gasket widths laid out accordingly. This is one of the essential features of carbureter flange design.

The flanges shown indicate a minimum gasket width of 11/32" on sizes ranging from 3/4" to 1 3/8" inclusive; on the 1 1/2" size, a minimum gasket width of 13/32"; on the 1 3/4" and 2" sizes, a minimum gasket width of 15/32"; on the 2 1/2" size, a minimum gasket width of 17/32", and on the 3" size, a minimum gasket width of 5/8".

BOLT SPACING—The spacing of the attaching bolts is such that United States standard cap screws can be used, allowing for sufficient clearance between the head of the cap screw and the outside diameter of the intake manifold, assuming that the inside diameter of the manifold does not exceed the actual opening of the carbureter and a reasonable wall thickness of the manifold.

U. S. STANDARD THREAD IN FLANGES—Tapped holes in the flanges have been indicated, specifying U. S. standard threads. The length of the tapped hole should be at least one and one-half times the diameter of the bolt. This method of attaching has proven absolutely satisfactory in practice, and is the most simple and inexpensive method of attaching the carbureter.

In the larger sizes, say from 2 1/2" up, it is common practice to use either three or four attaching screws, to which there would seem to be no objection. However, some manufacturers are furnishing carbureters as large as 3" with the two-screw flange, and are having no difficulty with them so far as is known.



GASOLINE AND HOT-WATER CONNECTIONS—In gasoline and hot-water connections the flared tube union is in favor for the following reasons: First, no packing is necessary; second, repairing is easy; moreover, it is more easily made than almost any other type, and certainly

CARBURETER SIZE	A MAX ALLOWABLE DIAM. OF OUTLET	B BOLT CENTERS	C DIAMETER OF FLANGE	D RADIUS AROUND BOLT CENTERS	E SIZE OF HOLES	F NOT LESS THAN 1 1/2 BOLT DIAM.
3/4"	13/16"	1 1/16"	1 5/8"	3/8"	5/16" x 18 U.S.S.	13/32"
7/8"	1 1/16"	1 1/8"	1 3/4"	3/8"	5/16" x 18 U.S.S.	13/32"
1"	1 3/16"	1 3/16"	1 7/8"	3/8"	5/16" x 18 U.S.S.	15/32"
1 1/8"	1 5/16"	1 1/4"	2"	3/8"	5/16" x 18 U.S.S.	15/32"
1 1/4"	1 7/16"	1 5/16"	2 1/8"	3/8"	5/16" x 18 U.S.S.	15/32"
1 3/8"	1 9/16"	1 3/8"	2 1/4"	3/8"	5/16" x 18 U.S.S.	15/32"
1 1/2"	1 11/16"	1 7/16"	2 1/2"	3/8"	5/16" x 18 U.S.S.	15/32"
1 3/4"	1 15/16"	1 5/8"	2 3/4	1/2"	3/8" x 16 U.S.S.	9/16"
2"	2 3/16"	1 3/4"	3 1/4"	1/2"	3/8" x 16 U.S.S.	9/16"
2 1/2"	2 11/16"	2"	3 3/4"	1/2"	3/8" x 16 U.S.S.	9/16"
3"	3 1/4"	2 1/2"	4 1/2"	5/8"	1/2" x 13 U.S.S.	3/4"

Diagram and tabulation of important dimensions governing carbureter standardization

is very inexpensive. Any union requiring a soldered joint is a rather unsafe proposition and at times quite difficult to repair, especially on the road.

Healthy dimensions are used throughout, especially on the flared union nut, which is to be of sufficient length to properly guide the tube, to relieve the joint of any strain, and to permit of the use of a rubber tube over the entire pipe and union, as extra assurance against leakage of gasoline from broken pipes.

The thread diameter and hexagonal portion of union nut are to be of such dimensions that neither will be damaged in drawing up with the wrench.

Instead of threading a portion of the float chamber and hot-water jacket, a nipple has been suggested, for the reason that some manufacturers may desire to use larger gasoline and hot-water pipes, in which case it would only be necessary for the carbureter manufacturer to tap the hole in the float chamber or hot-water jacket the proper size to take the nipple used in connection with the desired size of tube.

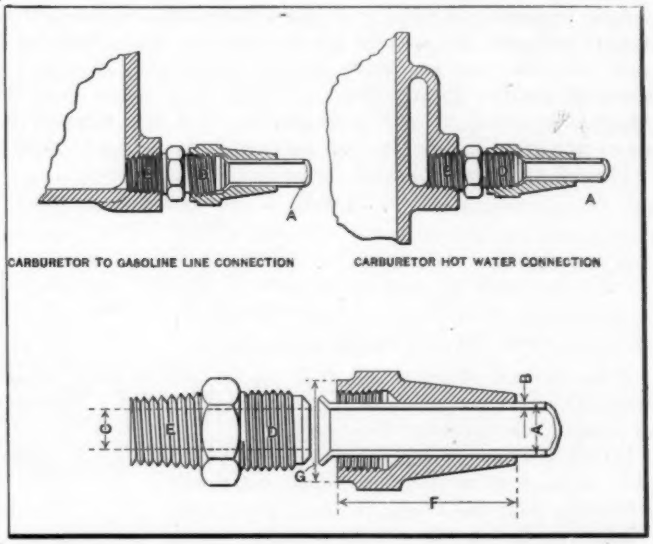
SIZE OF PIPE OR TUBE—In view of the fact that some automobile manufacturers use larger gasoline pipes than others, it is believed that it will be impossible to adopt any standard size of pipe or tube for a given size of carbureter. We are informed that one company is considering increasing the size of their gasoline pipe from 1/2" in 5/8".

GASOLINE SHUT-OFF COCK—The flared tube type of union is also recommended for use on the gasoline shut-off cock. The drawing given herewith shows a 3/8" O. D. gasoline line. The position of the shut-off cock when open is indicated.

THROTTLE LEVER—It is, in our opinion, possible to adopt a uniform diameter and thickness of boss to which the connection (ball-joint or clevis) is attached for connecting to the steering gear or accelerator pedal. It seems to be the consensus of opinion that the minimum length should be decided on, and that the longer levers should advance by quarter-inches.

There are, however, a number of opinions regarding the size of hole indicated by H on the drawing given herewith. One view is that this should be 1/64" greater than the diameter of the pin or bolt which passes through the same. These pins or bolts are in most cases 1/4" in diameter. The thickness of the boss indicated by G is 9/32".

G. G. BEHN, Chairman,
GEORGE M. HOLLEY,
J. G. STERLING,
HOWARD MARMON,
E. E. SWEET,
C. W. STIGER,
Carbureter Division.



A OUTSIDE DIAM. OF TUBE	B THICKNESS OF WALL B.& S. GAUGE	C DIAM. HOLE IN NIPPLE	D THREAD ON UNION END OF NIPPLE	E PIPE THREAD END	F LENGTH OF UNION NUT	G DIAM. ACROSS FLAT OF NUT & NIPPLE
1/4"	20	3/16	1/2" x 20 A.L.A.M.	1/8" PIPE THD.	1 1/8"	9/16"
5/16"	18	7/32	9/16" x 18 "	1/8" " "	1 1/4"	5/8"
3/8"	18	9/32	5/8" x 18 "	1/4" " "	1 3/8"	11/16"
7/16"	18	5/16	11/16" x 16 "	1/4" " "	1 1/2"	3/4"
1/2"	18	11/32	3/4" x 16 "	3/8" " "	1 5/8"	7/8"

Diagrams and tabulation of important dimensions governing standardization of hot water and gasoline connections to the carbureter

Report on Aluminum and Copper Alloys

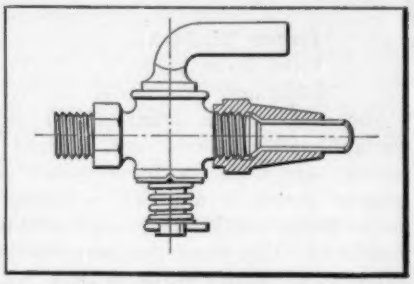
Being the second report on Specifications of the Aluminum and Copper Alloys Divison of the Standards Committee of the Society of Automobile Engineers, as of date of June, 1911, and subject to the vote of the Standards Committee.

BABBITT METAL—*Specification No. 24*

Tin	84.00%
Antimony	9.00%
Copper	7.00%

A VARIATION of 1 per cent. either way will be permissible in the tin, and .5 per cent. either way will be permissible in the antimony and copper. The use of other than virgin metals is prohibited. No impurity will be permitted other than lead, and that not in excess of .25 per cent.

NOTE: This grade of babbitt is special owing to the large amount of copper contained therein. It is used for the connecting-rod linings of motor bearings, or any service where machinery designers are confronted with severe operating conditions.



Gasoline shut-off cock (shown in open position)

WHITE BRASS—*Specification No. 25*

Copper	3.00 to 6.00%
Tin, not less than	65.00%
Zinc	28.00 to 30.00%

Metal with more than .25 per cent. impurities may be rejected.

NOTE: This alloy gives good results in automobile engines, but provision should be made to have it generously lubricated.

PHOSPHOR BRONZE BEARING METAL—*Specification No. 26*

Copper	80.00%
Tin	10.00%
Lead	10.00%
Phosphorus	0.05 to 0.25%

Impurities in excess of .25 per cent. will not be permitted.

NOTE: This is a metal similar to that specified by many railroads for various purposes. It is an excellent composition where good anti-friction qualities are desired, standing up exceedingly well under heavy loads and severe usage. It should be used only against hardened steel in automobile construction.

RED BRASS—*Specification No. 27*

Copper	85.00%
Tin	5.00%
Lead	5.00%
Zinc	5.00%

A tolerance of 1 per cent. plus or minus will be allowed in the above. Impurities of over .25 per cent. will not be permitted.

NOTE: A high grade of composition metal, and an excellent bearing where speed and pressure are not excessive. Largely used for light castings, and possesses good machining qualities

YELLOW BRASS—*Specification No. 28*

Copper	62.00 to 65.00%
Lead	2.00 to 4.00%
Zinc	36.00 to 31.00%

Total impurities in excess of .50 per cent. will not be permitted.

NOTE: This alloy represents a high grade of yellow brass; is tough and possesses good machining qualities. Its use is suggested in preference to ordinary commercial yellow brass castings which are, generally speaking, a miscellaneous assortment of mixtures, some of them containing considerable amounts of iron (from one to three per cent.). This is very undesirable, as it renders the castings liable to blow-holes, hard spots and, in some cases, small particles of metallic iron.

CAST MANGANESE BRONZE—*Specification No. 29*

Manganese bronze is understood to mean a metal constituted principally of copper and zinc in the approximate proportion of 60 to 40, iron being present in small and manganese in variable quantities. Main dependence will be placed upon physical specifications.

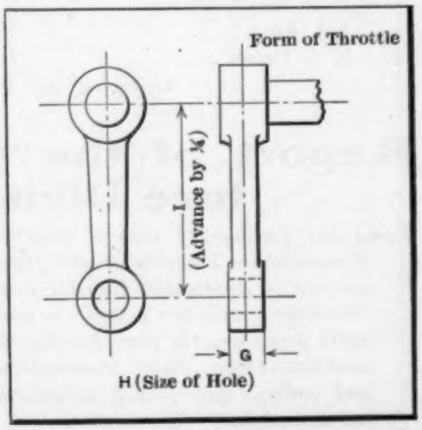


Diagram for use in preparing uniform throttle lever dimensions

	Lbs.
Tensile Strength	60,000
Yield Point	30,000
Elongation in 2 inches	20%

NOTE: Manganese bronze is of value for castings where strength and toughness are required. Specifications are not severe, being easily met by all makers of quality castings. Test coupons should be attached to castings made in the sand, the use of chills, special sand, or artificial methods of cooling being prohibited. This precaution prevents the use of inferior metals.

ALUMINUM ALLOYS—*Specification No. 30 (Aluminum Alloy No. 1)*

Aluminum, not less than	90.00%
Copper	8.50 to 7.00%

Total impurities shall not exceed 1.5 per cent. No other element than carbon, silicon, iron and manganese shall be allowed.

NOTE: This is one of the lightest of the aluminum alloys, possessing a high degree of strength, and can be used where a tough, light alloy of these characteristics is required in automobile construction.

ALUMINUM ALLOY No. 2—*Specification No. 31.*

Aluminum, not less than	80.00%
Zinc, not over	15.00%
Copper, between	2.00 and 3.00%
Manganese, not to exceed	0.40%

Total impurities shall not exceed 1.65 per cent., of which not more than 0.50 per cent. should be silicon, not more than 1.00 per cent. iron, and not more than 0.15 per cent. lead.

NOTE: This mixture possesses strength, closeness of grain, and can be cast solid and free from blow-holes. It is a light metal, its specific gravity being in the neighborhood of 3.00.

ALUMINUM ALLOY No. 3—*Specification No. 32.*

Aluminum	65.00%
Zinc	35.00%

Total impurities in excess of 1.65 per cent. will not be permitted.

NOTE: This is a mixture that can be used where cheap castings not to be subjected to any great strains are desired. It is a desirable mixture for flat plates, foot-boards, running boards, etc. It is quite brittle and will not equal in toughness or strength Nos. 30 and 31.

On aluminum alloys the standard specimen of reference shall be the same as indicated for Standard Steel Tensile Test Specimen. Test piece shall be tested with the skin on. We recommend a test bar 1-2 inch in diameter at the breaking section and filleted to a 3-4-inch diameter threaded end. Fillet should extend for at least 3-8 inch. Test bar to be attached to casting, use of chills or other artificial means of cooling being prohibited.

It seems unwise at this time to specify physical characteristics for the various metals. The idea is that competing manufacturers may name what they will guarantee with the standard specimen.

WM. H. BARR, Chairman. GEORGE M. HOLLEY.
GEORGE W. DUNHAM. S. P. WETHERILL, JR.
B. D. GRAY. F. W. COOKE.
J. J. AULL. THOS. J. FAY.
E. S. FRETZ. H. W. GILLETT.

Aluminum and Copper Alloys Division.

Report of the Nomenclature Division

Being the preliminary report (for discussion only) of the Nomenclature Division of the Standards Committee of the Society of Automobile Engineers, as of date of June, 1911. The report considers a uniform nomenclature of motor car parts in an orderly way, dividing the subject into four assemblies—power plant, transmission system, running gear and control system—and subdividing these into numerous sub-assemblies.

THE Nomenclature Division begs to present its report herewith. The Division held five meetings, two in December and the others on April 28, May 5 and May 12 of this year.

ASSEMBLIES AND SUB-ASSEMBLIES.—In taking up the work assigned to it the Division first divided the complete gasoline automobile chassis into a number of assemblies, and these into sub-assemblies. Names were then selected for all of the principal parts found in gasoline automobiles of what may be termed standard construction. In the selection of these names or terms, the Division made constant reference to the instruction books and parts lists issued by various motor car manufacturers, it being the understanding that the chief object of the work was to compile a list of terms for use in working up parts lists. It was found, however, that there is great diversity in the terms employed in these lists and instruction books. As far as possible descriptive terms were selected, but the advantage of brevity was also kept in mind. Further, the Division made it a point to select terms of considerable broadness for all such parts as may differ widely in construction.

EXAMPLE OF SELECTION OF TERM.—For instance, the drop forgings which are secured to the ends of tubular front axles and to which the steering knuckles are pivoted, are generally in the form of yokes, and are then properly referred to as steering yokes. However, in some cases the arrangement of the steering axle is reversed, the knuckle being developed in the form of a yoke and the axle end being merely a T-piece. In order to cover all possible constructions by means of a single term, the expression "Steering head" was adopted. No definitions of the terms are given, as they are all believed to be self-explanatory.

The list of terms suggested for adoption is as follows.

(Signed) P. M. HELDT, Chairman.
" A. L. MCMURTRY.
" THOS. J. FAY.
" A. H. WHITING.
" JOSEPH SCHAEFFERS.

POWER PLANT.

FUEL SYSTEM—Fuel tanks, fuel supply and strainer, intake manifold, carbureter, throttle, hot-air supply, pressure regulator or pump, gauge, pressure hand pump.

IGNITION SYSTEM—Magneto, battery, switches, spark plugs, coil, cables, high-tension distributer and timer.

COOLING SYSTEM—Pump, radiator, pipes, fan.

LUBRICATING SYSTEM—Tank, pump or pumps, pressure regulator, gauge, oil leads, sight feeds.

MOTOR—*Piston*—Head, wall, ring grooves, oil grooves, piston flange, piston rings boss, piston pin, piston pin lock, piston pin bushing. *Connecting-rod*—Connecting-rod, crank-pin bearing, upper half; crank-pin bearing, lower half; connecting-rod cap, connecting-rod stud—nut and lock, connecting-rod oil-scoop. *Valves and valve springs*—Inlet valve, inlet valve spring, inlet valve spring seat, inlet valve spring seat key, exhaust valve, exhaust valve spring seat, exhaust valve spring seat key, valve rocker-arm, valve rocker-arm pin, valve rocker-arm pin lock, valve rocker-arm fulcrum clevis. *Cylinders*—Water-jacket covers and gaskets, inlet plug, exhaust plug, petcock. *Crank-case assembly*—Crank-case, crank-shaft, flywheel, starting-crank, bearings, crank-shaft ends, crank-shaft gear—camgear, crank-shaft starting ratchet—pin, flywheel, flywheel studs, flywheel key, flywheel clutch stud—housing, starting-crank, starting-crank handle, starting-crank shaft, starting-crank shaft sleeve, starting-crank bearing—housing, starting-crank retainer, starting-crank spring. *Camshaft*—Push-rods, Push-rod springs, rocker-arms, accessory drive. *Manifolds*—Inlet, exhaust. *Exhaust system*—Exhaust pipe, cut-out, muffler.

TRANSMISSION SYSTEM.

TRANSMISSION—*Case*—Upper-half, Lower-half, cover, end-plate. *Shafts*—Driving pinion, countershaft, driven shaft, countershaft main gear, countershaft first gear, countershaft second gear, countershaft third gear, countershaft reverse gear. *Gears*—Sliding first (low speed), sliding second, sliding third, reverse idler, shifter rod, shifter fork. *Bearings*—Main forward, main rear, countershaft forward, countershaft rear, idler bushing.

Propeller-Shaft Assembly—Forward universal joint, rear universal joint, propeller-shaft, rear end tube, forward end tube, tube hanger. *Jack shaft assembly*—Differential and driving gear (see rear axle), right and left differential bearings, right and left differential shafts, differential shaft casing, jack shaft hangers, sprocket pinion, hub, center, right and left drive chain.

Clutch Assembly—*Cone*—Spring adjusting screw, thrust collar, male cone, female cone, facing spring, clutch spring, clutch sleeve, clutch collar, clutch yoke, clutch coupling. *Multiple disc*—Driving disc, driven disc, end plate, inner drum, outer drum, spring, spring adjusting screw, thrust collar, yoke, coupling. *Expanding or contracting*—Drum, band, facing, spring, spring adjusting screw, collar, yoke, coupling, expander—contractor.

Running Gear

Rear Axle Assembly—Axle outer bearings, right and left driving shafts, driving-gear housing, cover, right and left axle tubes and spring seat brake support, radius rod and radius adjustment for same. *Housing*—Torsion bar, torsion bar links, torsion bar springs. *Differential*—Right, left and thrust bearing, right and left case, spider, pinions, pinion studs, gears. *Driving gear*—Pinion, pinion shaft, forward bearing, rear bearing, thrust bearing, adjusting screw, adjusting screw lock.

Front Axle Assembly—Front axle, steering head, right and left knuckles, knuckle pin, knuckle pin bushing, knuckle spindle, right and left knuckle arm, knuckle thrust, tie rod, tie rod end, drag rod.

Frame—Right and left side bar; first immediate, second immediate, rear and front cross bars, front hanger and rear hanger front spring, front hanger and rear hanger rear spring, right and left jackshaft bracket, starting crank bracket, right and left radius rod bracket, torsion rod bracket, gusset plate, step brackets, fender brackets, pedal shaft brackets, lever shaft brackets, brake shaft brackets, quadrant.

Springs—Right and left front, right, left and cross rear, clips, leaf retainers, eye bolt, tie, shackles, eye bushing, pad.

Brakes—Drum, band, shoe, facing, expander, contractor, adjusting screw, brake arm, relief spring, stops.

Wheel Assembly—Front and rear hubs, hub flange, hub bolts, hub cap, inner and outer front wheel bearings, inner and outer rear wheel bearings. front wheel and rear wheel bearing spacers, front wheel and rear wheel spokes, front wheel and rear wheel felloe, front and rear band, rim.

Control System

Steering Post Assembly—Steering column, steering shaft, steering wheel, steering worm or pinion, steering wheel or sector, steering screw, steering nut, steering worm wheel shaft, steering arm, steering arm shaft, spark lever, throttle lever, spark sector, throttle sector, spark shaft, throttle shaft.

Hand Lever Assembly—Gear lever, brake lever, gear lever shaft, brake lever shaft, gate, brake lever sector, gear lever shaft arm, brake lever shaft arm.

Pedal Assembly—Clutch pedal, brake pedal, reverse pedal, accelerator pedal, foot button, clutch pedal shaft, brake pedal shaft, brake pedal shaft arm, clutch pedal shaft arm, primary brake rod, brake equalizer, secondary brake rod.

Radiator Needs Protection in Summer

Quite apart from the havoc that the beating rays of the sun play on the paint work and tires of a car when it is left in an exposed condition during the heat of the day, the radiator heats up tremendously under these same circumstances. After a stop, when the radiator has had a chance to heat up through standing exposed in this manner, it is no uncommon occurrence to see the best of cars emitting steam from the overflow pipe, and cases have been known where such disturbances have caused an air lock in the water cooling system with disastrous results.

As an example of the manner the radiator becomes hot one has only to take the upholstery as a concrete case. After the car has been standing in the sun for a few minutes it is almost impossible to sit on the cushions, but if these are covered with slip covers made of cotton or mohair the same inconvenience is not felt. A radiator should be covered with a duster or some similar protection when the car is standing in the sun.

Advantages of Long Addendum Gear

By E. W. Weaver, Member S. A. E.

A paper read at the Summer Meeting of the Society of Automobile Engineers, Dayton, O., June 15-17, in which is set forth the advantages to be derived from the lengthening of the addendum of the pinion tooth of a driving gear, with a corresponding shortening of the addendum of the gear tooth. While the field of its application is limited, the author points out the efficiency of the system, and gives formulæ for calculating the various dimensions for standard and long addendum bevel gears. He points out the advantage to be obtained from the very great improvement to be had in the shape of the tooth when the pinion has a small number of teeth, and gives outlines of several sizes of pinions and the mating gear in order that comparisons may be made between the standard and the long addendum gears.

THE bevel driving gears in the rear axle have probably given more trouble to automobile makers and users than any other two gears used on a car. For that reason any system of gear tooth design that tends to quieter running, greater strength or durability is deserving of consideration.

The system described in this paper is not new, although none of the authors of the standard gear books have deemed it worthy of more than a passing comment. It is, of course, understood that the tooth is of true involute or of octoid form, depending upon whether it is produced for a spur or bevel gear. The special feature of it is the lengthening of the addendum of the pinion tooth, with a corresponding shortening of addendum of the gear tooth—the whole depth remaining the same as in the standard tooth.

Opposed to Stub Tooth Gear Practice—This is in direct opposition to the advocates of the stub tooth gear, the strong point claimed for that being the absence of sliding contact of the meshing gear teeth, it being as near to full rolling contact as is possible with fixed

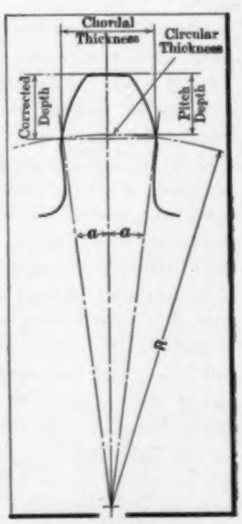


Fig. 2—Diagram to be used in finding the chordal thickness of spur-gear teeth

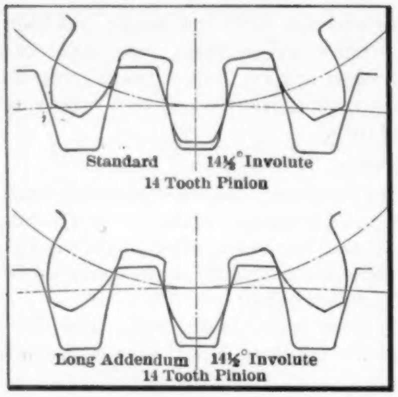


Fig. 4—Comparing standard and long addendum 14½° involute 14-tooth pinions

teeth. However, with the fully proven high efficiencies of properly cut worm or spiral gearing, the action of which is wholly sliding, the loss due to the greater sliding of the long addendum tooth may safely be set down as having been exaggerated.

With the addendum or face of the driver lengthened, the arc of approach of the gear tooth action is lessened and the arc of recess is increased—becoming all recess and no approach when the driver has only faces and the driven only flanks. This gives particularly smooth-running gears—almost equal, in fact, to spiral gears. As is well known, the friction of the arc of approach is much greater than that of the arc of recess—something on the principle of a man dragging a stick after him or of pushing it ahead of him. This is very well explained in Grant's Gear Book under the heading of "The Friction of Approach."

Pinions with Small Number of Teeth—Another advantage of this system is the very great improvement in the shape of the tooth when the pinion has a small number of teeth. Outlines of several size pinions and the mating gear are shown that comparisons may be made. It is readily seen that the pinion teeth with the long addendum are fully as strong as the gear teeth, while with the standard tooth they are not. This being the case, it is possible in designing a rear axle drive to select a smaller number of teeth for the pinion than one would otherwise wish to select—for instance, if the number of teeth previously used had been 17 and 54, the combination of 15 and 48 would give the same ratio, and would be fully as strong. With 5 1-2 diameter pitch tooth, the outside diameter of the large gear would be decreased something over an inch, thereby making the case that much smaller and lighter with all its inherent advantages.

Another disadvantage of using a small number of teeth in a pinion, with the standard tooth, has been the small amount of stock left between the bore for the shaft and the bottom of the tooth spaces. I have seen pinions in which, in my opinion, the keyway weakened the pinion seriously. This is gotten away from to a large extent by the decrease of the dedendum of the pinion tooth.

Field of Application—So much for its advantages. To look at the other side—its field of application is limited to gear sets having a large difference in the number of teeth in the gears and pinions on account of the gear tooth becoming weaker as the number of teeth decreases. The gear having the lengthened addendum must at all times be the driver, as in reversing the application of power the arc of recess becomes the arc of approach with its greater friction. This is of no account in the driving gears of a car, as in coasting no power is transmitted, except when there is a propeller-shaft brake.

It may also be said in objection that it is not a standard tooth and that introducing another system is to be deprecated.

Efficiency—One point which has not been touched on is the efficiency, and consequent life, of a gear of this system as compared with one of the ordinary or of the stub form of tooth. No exhaustive scientific tests to determine this have been made, to my knowledge; so it is a matter for further demonstration. However, so far as I have been able to learn, it compares favorably in this particular with either of the other types of teeth.

In the design of the tooth form it is necessary to fix on some definite ratio between the length of the addendum and dedendum. This ratio theoretically should vary with the angle of pressure which is being used. This is quite fully gone into in an article in the October 1, 1909, issue of the *Zeitschrift des Vereines Deutscher Ingenieure,* but as it is quite involved in its application I will leave it for those with the time and inclination to follow it out, without inflicting it upon all the members present.

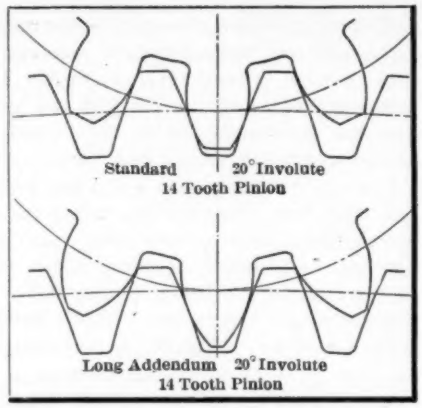


Fig. 5—Comparing standard and long addendum 20° involute 14-tooth pinions

For the remainder of the paper I am greatly indebted to the Gleason Gear Works, of Rochester, N. Y., for formulæ, sketches, etc., to which I have added some of my own.

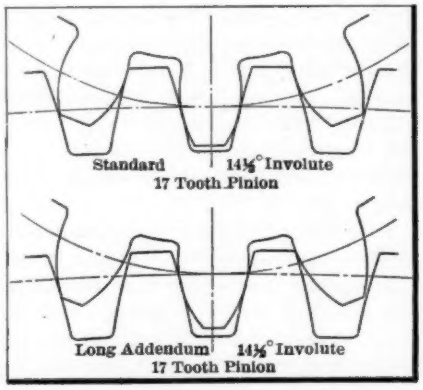


Fig. 6—Comparing standard and long addendum 14½° involute 17-tooth pinions

Finding Circular Thickness of Tooth—The addendum of the pinion tooth as further described in this paper is arbitrarily taken as 0.7 of its working depth, and 0.3 for the gear tooth for both 14 1-2 and 20 degree pressure angle. To find the circular thickness of the tooth, at the pitch line, for these depths, multiply the circular pitch by 0.5659 for the pinion, and by 0.4341 for the gear for 14 1-2 degrees pressure angle. For 20 degree pressure angle multiply the circular pitch by 0.5927 and 0.4037 respectively for the pinion and gear.

This is most easily seen from the rack tooth (see Fig. 1), which, being straight-sided, and the sides normal to the pressure angle, requires merely the solving of the triangle for the side BC and the adding or subtracting twice that amount from the normal circular thickness, depending upon whether the given pitch depth is greater or less than the normal depth.

Let a = normal pitch depth.
b = given pitch depth.
c = difference between a and b.
d = B — C (Fig. 1) = c × tangent of pressure angle.

Required circular thickness equals one-half circular pitch plus or minus 2 times d.

The impossibility of getting accurate circular measurements necessitates the calculation of the chordal thickness and corrected pitch depth. Referring to Fig. 2, let R equal the pitch radius for spur gear or the back cone distance for a bevel gear, angle a equals

$$\frac{360 \text{ degrees}}{\dfrac{\frac{1}{2}\; 2 \times R \times 3.1416}{\text{circular thickness}}}$$

Chordal thickness equals 2 × sine angle a × R.

Corrected pitch

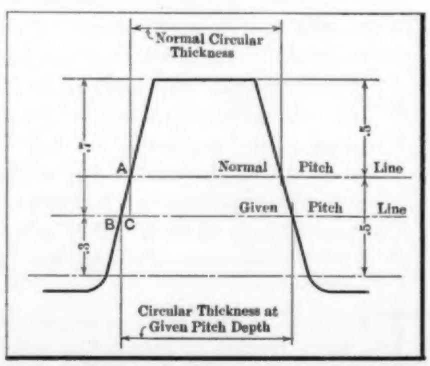


Fig. 1—Diagram for use in finding the circular thickness of the rack tooth

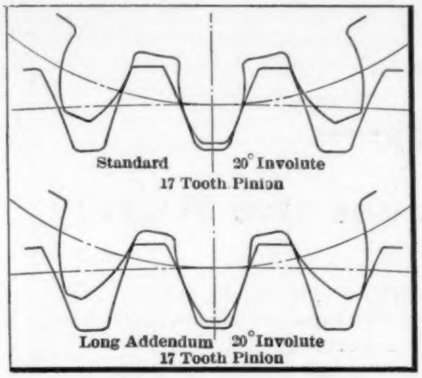


Fig. 7—Comparing standard and long addendum 20° involute 17-tooth pinions

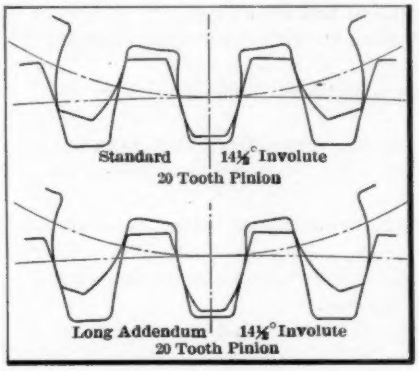


Fig. 8—Comparing standard and long addendum 14 1-2° involute 20-tooth pinions

depth equals versed sine angle a × R plus the given pitch depth.

I have tabulated these values for gears with as large a range of teeth numbers as the system is applicable to with advantage, in my opinion.

Chordal Thickness of Teeth for Spur Gears 1 Diametral Pitch Special Pitch Depth.

To obtain chordal thickness of teeth and corrected pitch depth for any diametral pitch other than 1 divide figures in table by diametral pitch required.

NOTE—For bevel gears, find chordal thickness of tooth and corrected pitch depth of gear with the same number of teeth as a spur gear having a diameter equal to twice the back cone distance.

REMEDYING GEAR NOISES — Nothing is more annoying to the automobilist than the noise produced by grinding gears. Such noises have often been cured for good by a change of lubricant, such as the substitution of a heavy grease for a light one, or grease with graphite for grease without, or even in one case, of sawdust with graphite for all other sorts of lubricants.

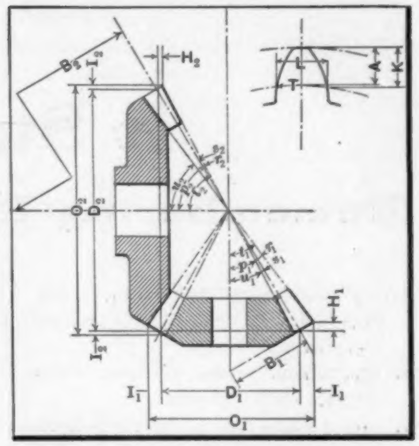


Fig. 3—Diagrammatic section of a bevel gear set indexed to aid in the working out of formulæ

DIAMETRICAL PITCH—STANDARD TEETH

Diametral Pitch.	Circular Pitch.	Nearest Metric Pitch or "Module."	Diametral Equivalent of "Module."	Circular Pitch Corresponding to "Module."
2¼	1.3962	11	2.309	1.3607
2½	1.2566	10	2.540	1.2370
2¾	1.1424	9	2.822	1.1133
3	1.0472	8	3.175	.9896
3½	.8976	7	3.628	.8659
4	.7854	6	4.233	.7422
4½	.6981	5.5	4.618	.6803
5	.6283	5	5.080	.6185
5½	.5712	4.5	5.644	.5566
6	.5236	4	6.350	.4948

20 PRESSURE ANGLE—FOR PINIONS ADDENDUM—EQUAL 7-10 WORKING DEPTH

Number of Teeth.	Chordal Thickness.	Corrected Pitch Depth.
12	1.8545	1.4720
13	1.8554	1.4665
14	1.8567	1.4618
15-16	1.8573	1.4559
17-18	1.8584	1.4495
19-20	1.8592	1.4442
21-22	1.8597	1.4402
23-25	1.8601	1.4361
26-29	1.8606	1.4316
30-34	1.8609	1.4272

FOR GEARS ADDENDUM—3-10 WORKING DEPTH

35-41	1.2792	.6107
42-54	1.2793	.6085
55-79	1.2794	.6060
80-134	1.2795	.6040
134	1.2795	.6030

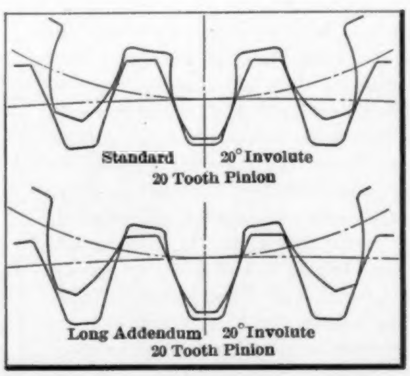


Fig. 9—Comparing standard and long addendum 20° involute 20-tooth pinions

I have also arranged the formulæ in the logical routine order for all necessary calculations for a pair of bevel gears of this system; symbols are as in Fig. 3.

As some firms are using the metric pitch or "Module" system, the conversion table herewith is given for their convenience.

FORMULÆ FOR LONG ADDENDUM BEVEL GEARS

Name.	Symbol. Pinion	Symbol. Gear	Formula. Pinion	Formula. Gear
Number Teeth	N_1	N_2	$N_1 = Pd \times D_1$	$N_2 = Pd \times D_2$
Diametral Pitch	Pd		$Pd = \frac{N_1}{D_1} = \frac{N_2}{D_2}$	
Circular Pitch	Pc		Table No. 1.	
Pitch Diameter in Inches	D_1	D_2	$D_1 = \frac{N_1}{Pd}$	$D_2 = \frac{N_2}{Pd}$
Pitch Angle	P_1	P_2	$\tan p_1 = \frac{N_1}{N_2}$	$\tan p_2 = \frac{N_2}{N_1}$
Working Depth	W		$\frac{2}{Pd}$	
Addendum	A_1	A_2	$A_1 = .7 \times W$	$A_2 = .3 \times W$
Dedendum	E_1	E_2	$E_1 = A_2 + G$	$E_2 = A_1 + G$
Clearance	G		$G = Pc \times .05$	
Full Depth	F		$F = W + G$	
One-half Diameter Increment	I_1	I_2	$I_1 = A_1 \times \cos p_1$	$I_2 = A_2 \times \cos p_2$
Outside Diameter	O_1	O_2	$O_1 = D_1 + 2I_1$	$O_2 = D_2 + 2I_2$
Circular Thickness	T_1	T_2	$T_1 = Pc \times .5927$	$T_2 = Pc - T_1$
Pitch Cone Distance	C		$C = \frac{D_1}{2 \times \sin p_1}$	
Back Cone Distance	B_1	B_2	$B_1 = C \times \tan p_1$	$B_2 = C \times \tan p_2$
Addendum Angle	r_1	r_2	$\tan r_1 = \frac{A_1}{C}$	$\tan r_2 = \frac{A_2}{C}$
Dedendum Angle	s_1	s_2	$\tan s_1 = \frac{E_1}{C}$	$\tan s_2 = \frac{E_2}{C}$
Face Angle	t_1	t_2	$t_1 = p_1 + r_1$	$t_2 = p_2 + r_2$
Cutting Angle	v_1	v_2	$v_1 = p_1 - s_1$	$v_2 = p_2 - s_2$
Distance from Crown to Pitch Line	H_1	H_2	$H_1 = A_1 \times \sin p_1$	$H_2 = A_2 \times \sin p_2$
No Teeth in Spur Gear Having Diameter Equal to Twice the Back Cone Distance.	S_1	S_2	$S_1 = 2 \times Pd \times B_1$	$S_2 = 2 \times Pd \times B_2$
Chordal Thickness	L_1	L_2	Table No. 2	Table No. 2
Corrected Pitch Depth	K_1	K_2	Table No. 2	Table No. 2
Angle of Tool Slides	×		$\tan \times = \frac{\frac{T_1}{2} + (E_1 \times \tan 20^{\circ})}{C}$	

It Stands to Reason—

(Remembering That the Exception Proves the Rule)

THAT it is a double undertaking to get a profit out of a thing that is not in demand—the second task comes in the selling process.

THAT the sinister power of mere words falls to the ground in the face of horse sense.

THAT it is a good idea to "ask a policeman" to point the way to jail, but it is better to ask yourself what kind of an automobile you need.

THAT revolution must not be permitted to settle down to its congenial work of slaughter of the good record that the automobile industry has grown.

THAT the word "vanquished" is written in invisible ink on the career of the cheat and the swindler.

THAT precaution should be taken against the introduction of infected ideas in an automobile.

THAT the swollen stream of misrepresentation must never be permitted to inundate the automobile business.

THAT the guillotine must be used to scissors the poignance out of marauding ideas that fester in automobiles.

THAT the legislature refrains from taxing go-carts as it does automobiles owing to poor promise.

THAT the automobile industry is crawling on its belly to whatever extent it launches new models before its late models are sold and paid for.

THAT the conception of a great partnership is represented when a maker of automobiles goes in to build a good car.

THAT the tenure of success of a builder of cars depends upon satisfied customers.

THAT the first morning call of a new design of automobile will suffice to mark its future prospects.

THAT all automobiles are not equally good any more than all nights are starry.

THAT it is almost a hopeless effort to prevent a "slant" idea from parading in deshabille.

THAT dignity is absurd when it perches upon the shoulders of a mistake in any garb.

THAT heights suggest depths, and that the ground taken in a given case must be firm, or danger lurks below.

THAT the editor, when he lifts the veil, has no right to substitute "rose-tinted" glass windows in its stead.

THAT doubt awakened will forestall a sale every time.

THAT a few good ideas subsidiary in a mediocre design of a car are lost to use.

THAT riches are held in high esteem when worth is laughed to scorn.

THAT the steadfast rock of immortality is poor having material for nondescript automobiles.

THAT wisdom's laugh is the clue for virtue to crouch.

THAT falsehood tramples fear when conscience dies.

THAT the master's voice is low, but the substance that lurks behind it is as hard as flint.

THAT the ghost of trouble that hides in an automobile stalks forth on dark, rainy nights on bad roads.

THAT merit in a design strikes the note of certainty.

THAT a good idea is nothing but a prisoner in a bad design.

THAT the automobile is the bridge that takes man across the raging torrent.

THAT, after all, the publicity man's poem is an earthly song.

THAT the mind of tne present touches the past placing the bloom of the peach upon it for the edification of the future.

THAT grossness is gigantic when it is shackled by greed.

THAT the "loom" of the automobile must produce its fabric from good ideas, or bow to the inevitable.

THAT we must take from the old as well as from the new.

THAT the huge output of the automobile plants is in response to actual demand.

THAT the men who would plunge their hands in jewels have difficulty in getting other persons to hold the pot.

THAT human energies were never so well enjoyed as they are to-day.

THAT the seed-pot of the automobile holds many secrets for the time to come.

THAT an optimist is a type of person who preserves his faith in a hopeless case despite the odor of decay that greets his nostrils.

THAT prosperity is a well-bred condition that shuns rude surroundings.

THAT noise in an automobile is reflected by the noise that emanates from the designer thereof.

THAT there are as many points of view as there are degrees in a circle.

THAT the principle of insurance is adequately portrayed in a drop of lubricating oil properly situated at the propitious moment.

THAT men differ about applied principles due to changing point of view.

THAT a primitive idea does not represent "simplicity."

THAT too many crimes of omission are paraded under the guise of simplicity.

THAT the sins of the engineering world are likely to greet the purchaser who expresses a preference for over-much automobile per dollar.

THAT value received is all that any purchaser can hope to say about a purchase once it is consummated.

Report of the Lock Washer Division

Being a preliminary report (for discussion only) of the findings of the Lock Washer Division of the Standards Committee of the Society of Automobile Engineers, and bearing date of June, 1911. A series of tables of proposed dimensions of washers for various purposes adds interest to this report.

THE Lock Washer Division has held meetings at which the various points in lock washer standardization have been considered, as well as the tabulation of data on practice received from S. A. E. members as a result of three circular letters sent them. Conferences have been held with representatives of leading lock washer manufacturers. From the statements made we consider the list of lock washer sizes submitted herewith to cover all reasonable demands of automobile engineering practice. It will be noted that lock washer specifications for U. S. standard bolts have been eliminated from Tables 5 and 6 up to seven-sixteenths (7/16") inch bolt diameter and three-eighths (3/8") inch diameter respectively. The reason for this is that the demand for lock washers of these sizes is considered by your committee to not warrant the lock washer manufacturers carrying the same in stock.

TABLE No. 1

Proposed Dimensions of Parallel Lock Washers for Short Diameters A. L. A. M. Standard Nuts

Section — Thickness = 3/4 Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
A1	1/4"	17/64"	3/8"	1/16"	3/64"
A2	5/16"	21/64"	1/2"	5/64"	1/16"
A3	3/8"	25/64"	9/16"	5/64"	1/16"
A4	7/16"	29/64"	11/16"	7/64"	5/64"
A5	1/2"	33/64"	3/4"	1/8"	3/32"
A6	9/16"	19/32"	7/8"	9/64"	7/64"
A7	5/8"	21/32"	15/16"	9/64	7/64"
A8	11/16"	23/32"	1"	9/64"	7/64"
A9	3/4"	25/32"	1 1/8"	11/64"	1/8"
A10	7/8"	29/32"	1 1/4"	11/64"	1/8"
A11	1"	1 1/32"	1 7/16"	13/64"	5/32"

TABLE No. 2

Proposed Dimensions of Parallel Lock Washers for Short Diameters A. L. A. M. Standard Nuts

Section — Thickness = Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
B1	1/4"	17/64"	3/8"	1/16"	1/16"
B2	5/16"	21/64"	1/2"	5/64"	5/64"
B3	3/8"	25/64"	9/16"	5/64"	5/64"
B4	7/16"	29/64"	11/16"	7/64"	7/64"
B5	1/2"	33/64"	3/4"	1/8"	1/8"
B6	9/16"	19/32"	7/8"	9/64"	9/64"
B7	5/8"	21/32"	15/16"	9/64"	9/64"
B8	11/16"	23/32"	1"	9/64"	9/64"
B9	3/4"	25/32"	1 1/8"	11/64"	11/64"
B10	7/8"	29/32"	1 1/4"	11/64"	11/64"
B11	1"	1 1/32"	1 7/16"	13/64"	13/64"

TABLE No. 3

Proposed Dimensions of Parallel Lock Washers for Long Diameters A. L. A. M. Standard Nuts

Section — Thickness = 3/4 Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
C1	1/4"	17/64"	7/16"	5/64"	1/16"
C2	5/16"	21/64"	37/64"	1/8"	3/32"
C3	3/8"	25/64"	21/32"	1/8"	3/32"
C4	7/16"	29/64"	51/64"	11/64"	1/8"
C5	1/2"	33/64"	55/64"	11/64"	1/8"
C6	9/16"	19/32"	1"	13/64"	5/32"
C7	5/8"	21/32"	1 5/64"	13/64"	5/32"
C8	11/16"	23/32"	1 15/64"	1/4"	3/16"
C9	3/4"	25/32"	1 21/64"	1/4"	3/16"
C10	7/8"	29/32"	1 7/16"	17/64"	3/16"
C11	1"	1 1/32"	1 21/32"	5/16"	1/4"

TABLE No. 4

Proposed Dimensions of Parallel Lock Washers for Short Diameters U. S. Standard Nuts

Section — Thickness = 3-4 Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
D1	1/4"	17/64"	1/2"	7/64"	5/64"
D2	5/16"	21/64"	19/32"	1/8"	3/32"
D3	3/8"	25/64"	11/16"	9/64"	7/64"
D4	7/16"	29/64"	25/32"	5/32"	1/8"
D5	1/2"	33/64"	7/8"	11/64"	1/8"
D6	9/16"	19/32"	31/32"	3/16"	9/64"
D7	5/8"	21/32"	1 1/16"	13/64"	5/32"
D8	3/4"	25/32"	1 1/4"	15/64"	11/64"
D9	7/8"	29/32"	1 7/16"	17/64"	13/64"
D10	1"	1 1/32"	1 5/8"	19/64"	7/32"
D11	1 1/8"	1 11/64"	1 13/16"	5/16"	15/64"
D12	1 1/4"	1 19/64"	2"	11/32"	1/4"

TABLE No. 5

Proposed Dimensions of Parallel Lock Washers for Short Diameters U. S. Standard Nuts

Section — Thickness = Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
E1	7/16"	29/64"	25/32"	5/32"	5/32"
E2	1/2"	33/64"	7/8"	11/64"	11/64"
E3	9/16"	19/32"	31/32"	3/16"	3/16"
E4	5/8"	21/32"	1 1/16"	13/64"	13/64"
E5	3/4"	25/32"	1 1/4"	15/64"	15/64"
E6	7/8"	29/32"	1 7/16"	17/64"	17/64"
E7	1"	1 1/32"	1 5/8"	19/64"	19/64"
E8	1 1/8"	1 11/64"	1 13/16"	5/16"	5/16"
E9	1 1/4"	1 19/64"	2"	11/32"	11/32"

TABLE No. 6

Proposed Dimensions of Parallel Lock Washers for Long Diameters U. S. Standard Nuts

Section — Thickness = 3/4 Width

S. A. E. No.	Bolt Size	I. D.	O. D.	Width	Thickness
F1	3/8"	25/64"	25/32"	3/16"	9/64"
F2	7/16"	29/64"	57/64"	7/32"	5/32"
F3	1/2"	33/64"	1"	15/64"	11/64"
F4	9/16"	19/32"	1 7/64"	1/4"	3/16"
F5	5/8"	21/32"	1 7/32"	9/32"	13/64"
F6	3/4"	25/32"	1 7/16"	21"64"	1/4"
F7	7/8"	29/32"	1 21/32"	3/8"	9/32"
F8	1"	1 1/32"	1 7/8"	27/64"	5/16"
F9	1 1/8"	1 11/64"	2 3/32"	29/64"	11/32"
F10	1 1/4"	1 19/64"	2 5/16"	1/2"	3/8"

TEST—Lock washers must be even and uniform in section, have panellel sides, and be free from bulging or malformed ends.

Temper—After compression under load equal to the elastic limit of the bolt, the reaction shall be sufficient to indicate spring power, hardness and freedom from set; reasonable allowance will be made for differences in dimensions of section and internal diameters.

Toughness—A small portion of one end of the lock washer, being held firmly between the jaws of a vise, and the opposite free end swung off with a wrench to 45 degrees, the lock washer must not break or fracture; should it break at about 90 degrees, it would not be considered too hard, nor too soft.

CHEMICAL COMPOSITION SPECIFICATION OMITTED—The Division thinks it advisable to omit chemical composition specification of the steel from which lock washers shall be made, because the physical characteristics provided for above are sufficient to insure safety, endurance and high resiliency. This is believed to be fair. Long experience in handling lock washer products has developed diverse methods of heat treatment based upon the material used in their production.

It is desirable for all interests that stock sizes shall be carried. The lock washer manufacturers promise to do this as soon as a standard is established, and answer quickly the demands of the trade.

(Signed) J. E. WILSON, Chairman,
A. C. BERGMANN,
H. A. BUGIE,
F. W. HART,
F. S. SAYRE,
COKER F. CLARKSON,
Secretary.

AN AID IN PREPARING A CAR FOR THE ROAD—To aid the motorist in adhering to a standard procedure to follow in getting a car ready for the road it would not be amiss for him to memorize the words WON'T GAT, the initial letters of words describing the various operations, as follows: W-ater; O-iling; N-uts and bolts; T-ires; G-asoline; A-cetylene; and T-rying-out.

What Some Subscribers Want to Know

> *The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their automobile troubles, stating them briefly, on one side of the paper only, giving as clear a diagnosis as possible in each case, and a sketch, even though it may be rough, for the purpose of aiding the Editor to understand the nature of the difficulty. Each letter will be answered in these columns in the order of its receipt. The name and address of the subscriber must be given, as evidence of good faith.*

Tight Fits Overcome With a Reamer

Editor The Automobile:

[2,701]—I have been troubled for some time with a rattling of the timing gears of my car and there seems to be some play in the bushing that carries the magneto and pump drive-shaft. I might mention that where this shaft leaves the gearcase there is a pulley wheel used for the fan belt drive. If I hold the shaft with a piece of waste while the motor is running the noise ceases. Is it possible to have a new bush fitted without having the motor dismantled? The repairman tried it the other day, and when the bush was placed on the shaft before inserting in the case it was a nice snug fit, but after he had driven it into the case, which is made of aluminum, the shaft would not enter. What is the cause of the trouble, and how can I have the job done without having the motor taken out of the frame? It does not make the motor run any differently as far as I can see, but the rattle is most unpleasant. Troubled.

Amesbury, Mass.

The bush being made of phosphor bronze presumably contacts when being driven into the casing and will need reaming. There is no necessity to take the motor down for this operation, as it can easily be fixed by using a reamer in the manner shown in Fig. 2. The reamer R1 is inserted in the hole and can be turned by using an ordinary wrench W1. You are probably running your fan belt too tight, and if it is a flat one there is no necessity for this. Disalignment of the pump shaft, unless there is a universal joint in it, will also cause the wear that you complain about.

If a reamer is not on hand the following method can be employed: Take a piece of steel tubing slightly smaller than the hole and cut a slot in one side so as to be able to introduce a piece of fine emery paper therein in the manner shown in Fig. 1. This will form a lapping tool and the amount to be removed can be gauged by the thickness of the layers of emery paper. To the left is shown the emery wrapped around the tube.

A Wins

Editor The Automobile:

[2,702]—Several friends of mine have entered into a controversy as regards which wheels of an automobile leave the ground when taking a curve at a high rate of speed. For example, A bets that when a machine goes around a curve bearing toward the right that the right hand, or inside wheels, leave the ground, while B bets that the left hand, or outside wheels, leave the ground. As the interested parties have agreed to submit this query to The Automobile for decision, we would greatly appreciate the courtesy of a reply in the next issue of your paper.

New York City. Bennett Milnor.

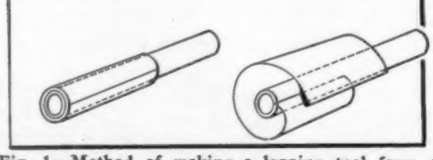


Fig. 1—Method of making a lapping tool from a piece of steel tube and emery paper

More Attention Should Be Paid to Brake Adjustments

Editor The Automobile:

[2,703]—Having been operating a car for about ten months I find that the foot-brake will no longer hold. There is ample thickness to the brake liners, but the adjustment is no longer of any use. The rod that applies the brake forms part of a crank and as the arm that turns the operating rod is pinned to the shaft I should like to have you tell me the best method of overcoming the difficulty. R. C. B.

Springfield, Mass.

If you are not disposed to go to much trouble, one way is to drill another hole in the arm so as to increase the leverage and by letting out sufficient of the adjustment you will be in the same place as when the car was new. An excellent method, however, and one that will be a permanent benefit, is shown in Fig. 3. There are two distinct and independent adjustments, one that will take but a minute to keep the brake tight at all times, and the other that can be set from time to time as occasion demands.

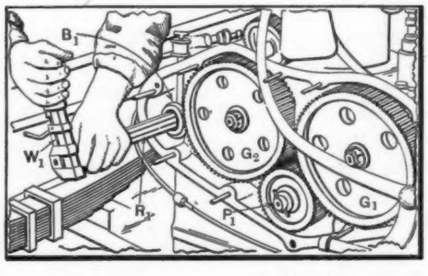


Fig. 2—Method of reaming a tight bushing without otherwise disturbing the motor

The Running Balance Would Be Relatively Poor

Editor The Automobile:

[2,704]—Can you tell me what effect on the balance of a four-cylinder four-cycle engine would be brought about by working the pistons in adjacent pairs instead of the usual way? I mean to work 1 and 2 and 3 and 4 together instead of 1 and 4 and 2 and 3. The firing order would be 1-4-3-2 instead of 1-3-4-2 or 1-2-4-3. If you think the balance would be disturbed please say if your opinion is founded on theory or actual experience, and if on experience was the order of firing the same?

Also please say what results have been obtained by intake valves placed in the piston head. I have a motor so built, the charge being drawn into the crankcase something like a two-cycle motor. Having obtained some excellent results as to economy in oil and gasoline and in brake horsepower, I explain the economy in oil by the cooled piston, in gasoline by the perfect vaporization and the horsepower by the fact that the charge is nearly perfect. I might say that the valve is seated in an easily removed cage, the cage being held in place by four screws and the cylinder head by two. Interested.

Detroit, Mich.

The few opportunities that we have had to observe the performance of experimental motors of the type in which the pistons were not paired off does not encourage us to recommend the plan. Perhaps some reader can relate a real experience along this line, the same to be of recent date. The intake valve in the piston head should have the effect as related, but we do not know how access might be had to the valve for the purpose of grinding in the same when the occasion comes up. Accessibility is worth a whole lot in the normal course of the operation of a motor.

Everything Depends Upon Circumstances

Editor The Automobile:

[2,705]—Does a 4 1-2 inch bore by 5-inch stroke engine develop any more power than a 4 1-2 square, both engines four cylinders, cast separately. I am a subscriber to your magazine and you may answer this in your next issue. Emory G. Streeter.

Lyons, N. Y.

The temptation would be to say that the motor with the greatest length of stroke for a given bore would deliver the most power. In the meantime, there are quite a number of conditions that might creep in through

What Other Subscribers Have to Say

The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their personal experiences for publication in these columns for the worthy purpose of aiding brother automobilists who may be in need of just the information that this process will afford. Communications should be brief, on one side of the paper only, and clearly put, including a rough sketch when it is possible to do so, and the name and address of the writer should be given as evidence of good faith.

the intereference of the plan, sufficiently to upset a prophecy of this sort. Within certain limits the power of the motor is settled by the bore to the disregard of the stroke, assuming that the piston travel in feet per minute is the same in both cases. But even this observation must be accepted with a grain of salt. The plain truth is that the power obtainable from a motor depends upon a certain harmony of relations, and this condition is so easily upset that it is not safe to promise more power where it would seem to be feasible; moreover, to make an abstract comparison counts for nought these days.

Perhaps the Fountain Head Will Give Information

Editor THE AUTOMOBILE:

[2,706]—As a subscriber to THE AUTOMOBILE I would like to ask if you can tell me of some good reliable self-starting device for an automobile, something that has passed beyond the experimental stage and has proven a success and is satisfactory. Which in your judgment do you consider the best? We out here are so far from the source of such things that it takes time to reach us, and I am anxious to secure a good starter for my machine. Please give maker's name and address.

Monrovia, Cal. A. E. HACKER.

The Condition of Balance Is Relative

Editor THE AUTOMOBILE:

[2,707]—The question has arisen as to a well-balanced engine. For instance, the car I have in mind has three speeds, the first very good and the second extremely mediocre. What I would like to know is would it be right to say the car has not a well-balanced engine? I would like the opinion of an experienced machinist.

Mineral City, Ohio. MRS. J. IRA DAVY.

In referring to the balancing of a motor, it must be approached from two points of view, the first of which has to do with the static (standing still) balance, and the second phase of the problem deals with the kinetic (running) balance, and it is a fair approach to accuracy to say that a motor may be perfectly well balanced statically, and yet be thoroughly out of balance when it is running. Some motors show lack of kinetic balance at moderately low speeds, and other motors are capable of being operated at very high speeds without showing distress. When a motor is placed in an automobile, if it is in a state of poor static balance there will be considerable vibration when the speed is low, but if the motor operates steadily at the lower range of speed and vibrates when the speed is increased considerably, this is a sign of poor kinetic balance.

A Feeler Gauge Is an Inexpensive and Useful Tool

Editor THE AUTOMOBILE:

[2,708]—How is it possible to measure parts down fine enough such as the fit of

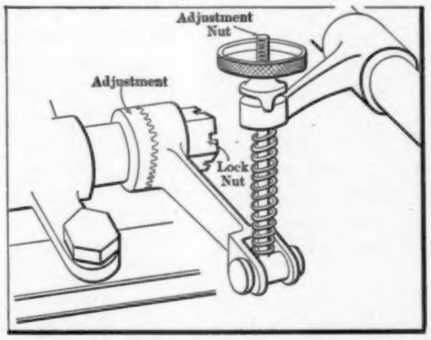


Fig. 3—Method of altering present bell crank brake fittings so that wear can immediately be taken up

a collar or engine bearing? I have recently taken my motor down and find that there is a difference in the end play of the crankshaft bearings. These undoubtedly should be all the same. I would be obliged if you will tell me how I can ascertain what the difference is in order to overcome this.

Rahway, N. J. T. W. W.

The best way is to purchase a feeler gauge such as is shown in Fig. 4. These can be obtained in several combinations, but the one shown is in divisions of an inch, and besides being useful for bearings it can be used with advantage in the setting of the valves of the motor. By inserting various sizes it is possible to maintain an equality if the feet are fitted with adjusters.

Something Out of the Ordinary in Speedometers

Editor THE AUTOMOBILE:

[2,709]—Will you kindly inform me if you know of a speedometer on the market in which the "trip" mileage can be turned ahead or back at will. In other words, in which if I want to leave a certain place and set the trip at 15.6 miles and then should want to within a mile or so set it ahead three or four miles or back a little distance. M. I. STEVENS.

Milwaukee, Wis.

Looking for a Boston Dealer in Second-Hand Motors

Editor THE AUTOMOBILE:

[2,710]—Can you put me on the track of a second-hand automobile engine that would be fit for use in a boat? Can you give me the names of any dealers in Boston?

Gardiner, Me. WM. M. PALMER.

Subscriber Wants a 50 Horsepower Self-Starter

Editor THE AUTOMOBILE:

[2,711]—Kindly give the writer the name and address of the manufacturers of self-starting devices suitable for 50-horsepower four-cylinder car. WALTER TIPS.

Austin, Tex.

Willys-Overland Company, Toledo, Ohio

Editor THE AUTOMOBILE:

[2,712]—Please inform me through your "Letters Column" where I could get parts for a 1906 or 1905 Pope-Toledo car, as the factory is out of existance?

Chester, Pa. A SUBSCRIBER.

Keenly Interested in a Good Truck as Specified

Editor THE AUTOMOBILE:

[2,713]—Kindly refer us to such of your advertisers as are producing the nearest thing that you know of to a truck as described below:

Something of a simple strong construction; nothing more necessary than two cylinders, with either water or air-cooled; capacity about 2,000 pounds; made by a good firm and sold at a reasonable price.

GLENN H. FOOTE.

Ransomville, N. Y.

R. A. C. Horsepower Formula

Editor THE AUTOMOBILE:

[2,714]—Kindly give me the formula for computing horsepower of gasoline engines as used by R. A. C., in England, and what would be the power of a six-cylinder engine of 4½-inch bore and 5-inch stroke, rated 48.6 horsepower A. L. A. M.? MACK.

Chatham, N. B., Can.

The R. A. C. horsepower formula $0.4D^2 \times N$, or 0.4 times the bore times the number of cylinders gives a rating of 48.6 horsepower.

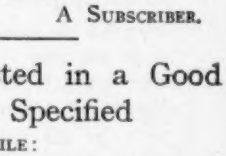


Fig. 4.—Play can often be located with a feeler gauge

When Judgment Whispers Don't

A Series of Abbreviated Injunctions

DON'T go before the bar of pure reason claiming exclusive advantage for a passing fancy.

DON'T see in the graven past a distorted embossing of the future prospect.

DON'T look upon work as a reluctant ally—it plays the better part of willing slave.

DON'T scan the seed-pot of the future with a too longing eye—the present cries for lack of attention.

DON'T pay out money for what you see in a picture—it may resemble an automobile with a difference.

DON'T say "damn the consequence" and buy the first car offered; the consequences will probably decline the proffer.

DON'T take too much stock in the idea that an automobile will be good for you because it is "fool-proof"—does the maker of this car take you for a person of that calibre?

DON'T vie with the salesman who is bent upon fastening a crude device to your string of misfortunes.

DON'T emulate the characteristics of a Missouri mule, persisting in gratifying the whim of the man who would sell to you what you know you do not want.

DON'T stunt your intelligence to the extent of believing that your garden is the only place that grows weeds—what about some of the second-hand automobile gardens?

DON'T be a dumb statue when you go after a car; if you ask enough pointed questions and insist upon getting answers you will have nothing to rue.

DON'T let the salesman muzzle you unless you are willing to admit that you belong in the classification of mad dogs.

DON'T mutilate your equanimity and spoil the maker's good opinion of you by demanding an iron-clad guarantee, which in all fairness might be written around an inferior product as well as a good car.

DON'T attempt the crossing of the mystic gulf that separates the description of a poor car from the facts as they are portrayed therein.

DON'T vie with Satan to the extent of encouraging a false description of an inferior product.

DON'T be unreasonable in your demands; the seller must make a profit, or he will vacate before you give him a chance to sell you repair parts.

DON'T assume the responsibility of having a mission in life if it takes on the shape which will require you to tell the makers of automobiles about the ideal car that you think they should devote their energies to.

DON'T yield to the vagrant thought that a tonneau is what you want if your neighbor has a large family.

DON'T join in the project of reforming the maker of a poor product by the simple process of taking it off his hands so that he can do better the next time.

DON'T allow the meaning of the word "explicit" to become dimned in your memory; it means something when you go in quest of a car.

DON'T lay too much stress upon necromancy as it rolls off the tongue of the fellow who thinks he knows more about what you want than you do yourself.

DON'T be inconsistent to the extent of having a "search" made when you buy real estate and take an automobile without asking two questions.

DON'T offend the conventions by placing overgrown accessories upon an otherwise well-behaved automobile.

DON'T add to the burden of the distiller of lubricating oil by using twice as much of it as there is any occasion for.

DON'T substitute oleomargarine for suitable grades of grease in the lubrication of ball bearings.

DON'T deal wholesale in uncertainties in conjunction with the lubrication problem.

DON'T have such a love for the antique that you take it into the automobile business.

DON'T be open to conviction when you are on the wrong scent.

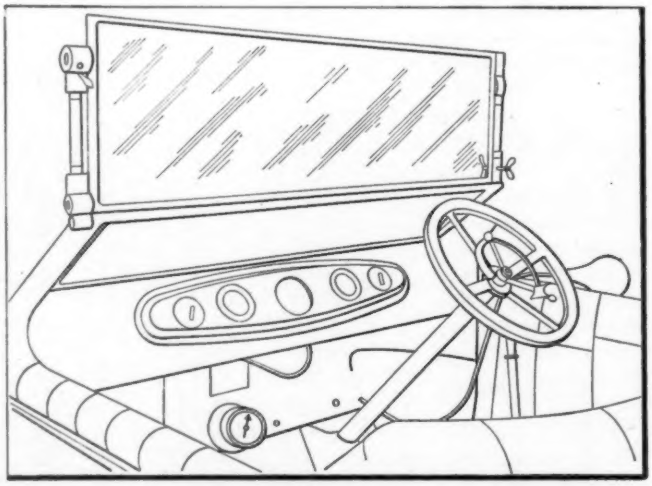
DON'T take an option on a fallacy and persist in making good.

DON'T impeach your acumen by playing second fiddle to a knave.

DON'T imagine that an automobile has anything to do with astronomy; if you cannot find the trouble in the car it is because you lack knowledge.

DON'T make a chamber of horrors out of your garage.

DON'T suppose that you will be the original numskull if you accept the type of car that will not match up with the intended service.



Showing how the dashboard fittings can be fixed to a supplementary dash for use in closed cars and touring cars with cowl dash

Dashboard Fittings and the Cowl Dash

TIME was, not so very long ago at that, when the dashboard of a car was used as the maker's dumping ground for any part that he could not conveniently place elsewhere. The advent of the magneto and pump oiling system has done much to improve matters, but there are so many fittings sold at the present day for the autoist's convenience that the dash is beginning to become as crowded as ever. This in itself is not a detriment, but with the present-day coach work such fittings serve little utility owing to the difficulty of reading them or the difficulty of reaching them through the obstruction of the cowl dash that has done so much to improve the appearance of the car.

If the mountain will not go to Mahomet, it is a matter of so placing the sundry fittings that the autoist can see and get at them without difficulty. The example shown in the illustration is a logical solution to the apparent shortcomings of the new style of dash. It can be made of sheet metal with a metal extension to accommodate the parts, but in the case of existing cars where it would require dismantling to make a fit, a wooden board

could easily be made and stained to suit the particular colors of the trimmings. The supplementary dash here depicted carries the coil and magneto switches, a speedometer, clock and pressure gauge, and as it is set slightly at an angle facing the driver, the light question is a negligible quantity. There is no reason why the lubricator glasses could not be fixed on this additional part with advantage, and with the aid of a single light the readings would be as clear at night as during the daytime.

A further suggestion, and one that would appeal to the owner who looks after his own car, would be to have the sundry adornments enclosed in a glass-covered recess, of course with the exception of the switches, which would place them out of the meddler's reach and the cleaning operations would be avoided. The inclemencies of the weather would no longer affect the luster, and if the glass were made to lift on hinges the further advantages of this addition will be apparent to any one.

Improvising a Roadside Forge

When soldering is to be done and a blow torch is not at hand, the autoist can construct a "forge" from the dirt on the road, making a circular mound, say about eight inches high and a foot in diameter, saturating this with gasoline and setting it on fire. The soldering iron can be heated in this dirt "forge" just as well as in an ordinary shop forge, and the fire will continue to burn for a surprisingly long time.

In making up a fire such as the above care should be taken to locate it at the side of the road, in a sheltered position, so that a gust of wind will not scatter the flaming dirt over the car and cause a conflagration.

As soon as the operation is finished the flames should be smothered with dirt and the "forge" broken up and scattered over the road.

Discussing the Abbott-Detroit Car

Presenting Detail from the Purchaser's Point of View

It is pointed out in the story that a single type of power plant rated at 25.6 horsepower is used in five models of the cars, and the illustrations are designed to show the details involved in the construction with particular reference to the power plant and the accessories attached thereto.

PERHAPS the demi-tonneau, as shown in Fig. 1, is sufficiently illustrative of the general plan of design of the Abbott-Detroit automobile as made by the Abbott Motor Company of Detroit, Mich., to serve the broad purpose here, if the reader will remember that the company offers five options, including three designs of cars for touring, a roadster and a coupé.

Confining further discussion to the ramifications of the chassis, remembering that the motor is rated at 25.6 horsepower (A. L. A. M.), the bore of the cylinders is 4 inches and the stroke 4 1-2 inches, there being four cylinders cast in pairs, and water-cooled, it remains to observe that the cellular type of radiator used in conjunction with a centrifugal type of water pump W1, as shown in Fig. 2, are in harmony with the plan. A further examination of the left-hand side of the motor, as presented in this figure, indicates the use of a magneto M1 for ignition purposes, located on a shelf S1 held in place by bolts B1 and B2, and driven by a shaft through a universal joint U1 between the magneto and the water pump, extending therefrom to a gear in the housing H1 with a pulley P1 intervening, over which a belt B3 runs, driving the air propeller P2, and a grease cup G1 is located on the bearing of the air propeller for lubrication purposes, and another grease cup G2 is so fitted as to lubricate the outboard bearing of the shaft that drives the water pump and magneto, so that the gear for the same as it meshes with the half-time train is supported on both sides, thus saving noise and preventing undue wear and tear. A further examination of this side of the motor shows an oil pipe P3 leading up from the oil reservoir W2 from a fitting F1 at the lowest point to the pump P4 by means of which the lubricating oil is kept circulated. The reservoir holds 1 1-2 gallons of free oil, and while the lubricating method is ostensibly by "splash," the oil pump, which is the plunger type, is a positive means of circulation, and it has the further facility of maintain-

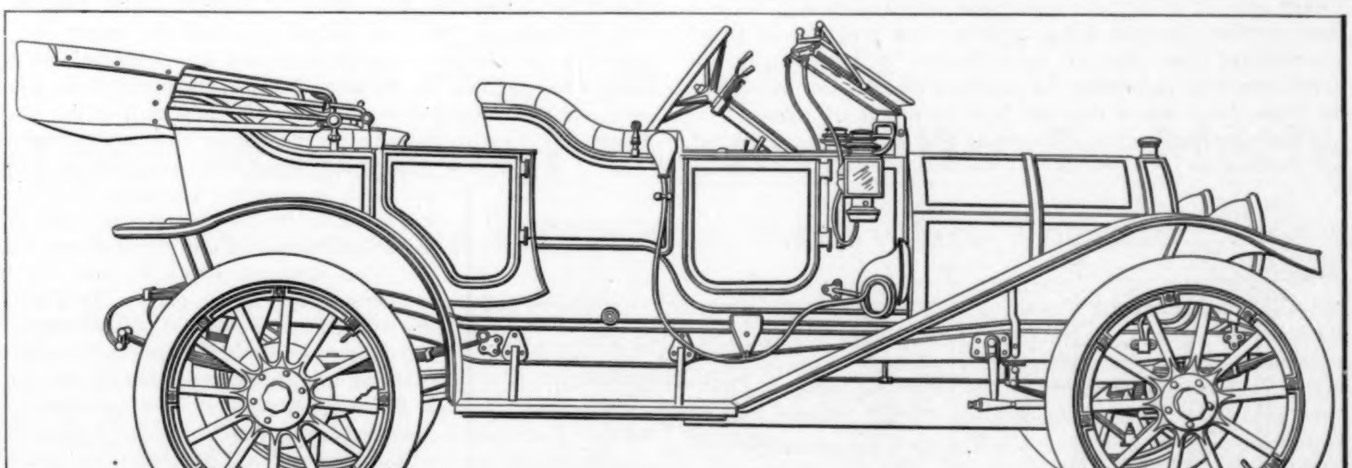


Fig. 1—Side elevation of the demi-tonneau of the foredoor type, fitted with top and wind shield

ing a constant level of the lubricant. The valves being overhead, require the use of rockers R1, of which there are four, and attention is called to the stout brackets B4 supporting the rockers, and the lift rods L1 engage the tappets, the latter being in the guides G3 in the plane of the camshaft, and in the design of the camshaft provision is made for the quick removal of the same with the assembly of its bearings. The exhaust manifold M2 is of gradually increasing diameter with an easy sweep for the purpose of preventing back pressure and in the bolting of the manifold to the faces of the cylinders care has been taken to bring the bolt centers out so that they can be gotten at with a wrench.

Fig. 3 shows the right-hand side of the motor, and the carbureter C1 flanged to the intake manifold M1, the latter having branches B1 and B2 terminating between the valve chambers, which are separable and bolted to the tops of the cylinders with holding bolts B3. In order that the lubricating oil can be cleaned out of the reservoir R1 a plug P1 is provided at the low point, and the high level of the lubricating oil is fixed by the draincock C2 with a second draincock C3 at the low level, as a matter of convenience. On this side of the motor the fulcrum pin P2 upon which the bracket B4 swivels, carrying the fan F1 by means of which the belt B5 is maintained in the tight relation. In the flywheel F2 air veins V1 are placed, the idea being to supplement the effort of the air propeller or fan F1, thus assuring an adequate flow of cooling air through the radiator, which is thereby enabled to do its work effectively.

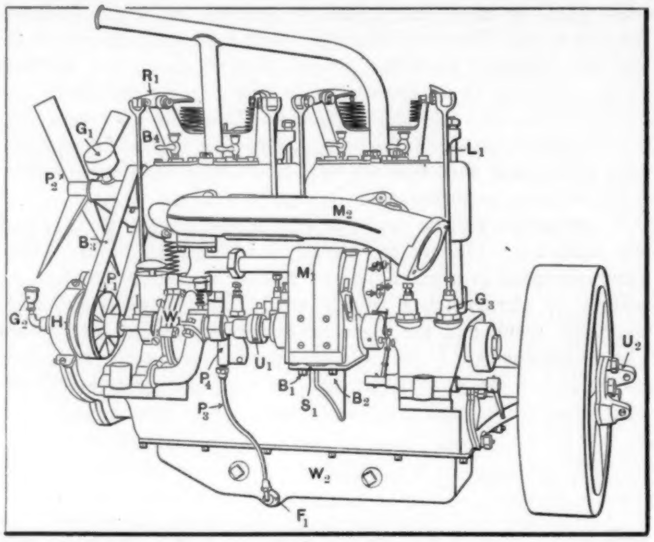


Fig. 2—Left-hand side of the motor showing the location of the magneto, water and oil pumps

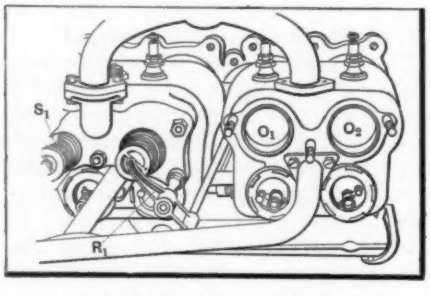


Fig. 5—Looking down on the motor showing the valves and the method of their housing

Referring to Fig. 4 of the motor looking at the underside with the reservoir removed, attention is called to the baffle plates B1, B2, B3 and B4, which prevent the lubricating oil from surging from one end to the other, due to the gradient produced by the automobile going up or down hill, and the excesses of lubricating oil flow to the bottom of the pan through the openings E1 and E2 at the end. Looking into the motor, it will be seen that the main bearings M1, M2 and M3 are self-contained. The camshaft C1 is also exposed, showing supporting bearings B5 and B6 in addition to the end bearings.

Looking down on the top of the motor, Fig. 5 discloses the rocker arm R1 to actuate each valve with the springs S1 in a clear position, the idea being to keep them cool and to afford accessibility. One pair of the cylinders is shown with the valves removed, presenting the openings O1 and O2, into which the cages drop, where they are held by means of yokes.

The transmission gear is shown in Fig. 6, with the cover off, with a multiple-disc clutch in the extension of the housing H1, and a universal joint U1, of which there are two on the tumble shaft, and referring to Fig. 2 it will be seen how the remaining member of the universal system fastens to the flywheel at the point U2. The transmission gear affords three speeds and reverse, it being of the selective type with a gate G1 in the hollow of the arm, which is somewhat enlarged to afford the necessary room. Referring to the multiple-disc clutch, which is made in a unit with the transmission gear, it is pointed out that the clutching members are made of saw-blades, partaking of the hardness and density that is characteristic of this type of material. The gears in the sliding gear system are of chrome nickel steel, and the prime and lay shaft, both of which are of good diameter and short, float on annular type ball bearings. The shafts are of double heat-treated nickel steel.

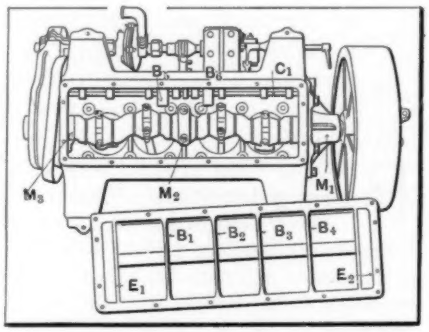


Fig. 4—Underside of the motor with the reservoir removed showing the bearings and other details

By referring to Fig. 7 it will be seen how the motor M1 is placed in the chassis frame between the side bars B1 and B2 back of the radiator R1, the latter being in the plane of the front axle, and the transmission gear G1, with the clutch in the same housing, is located amidship, remembering that a tumbleshaft with two universal joints takes the power of the motor through the flywheel to the transmission gear from whence it travels through the propeller shaft P1 to the live rear axle A1, with universal joints U1 and U2 to compensate for spring play. The plan is flexibility, and the method of execution of the design takes into account the desirability of being able to remove either of the units if the occasion requires, without disturbing the neighboring units. In the furtherance of this idea of flexibility, the torsion rod T1 prevents the live rear axle from turning, thus cramping the propeller shaft, but it does not interfere with the lateral sway of the chassis within the limits as fixed by the flexibility inherent in the three-quarter elliptic rear springs S1 and S2 supporting the

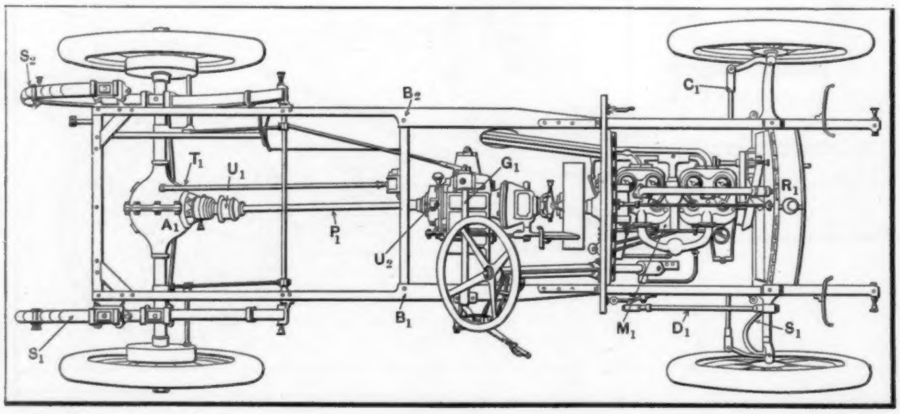


Fig. 7—Plan of the chassis showing the location of the relating units and a clean design

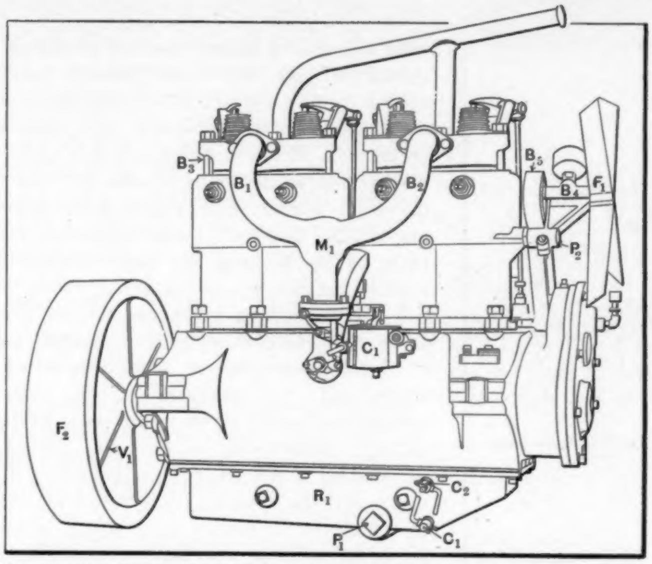


Fig. 3—Right-hand side of the motor showing the location of the Mayer carbureter

chassis. At the front end of the half-elliptic type, and in the design of the I-section axle the cross rod C1 was brought to a protected position in the rear and the drag rod G1 connects to the steering arm S1 above the axle, and considering the fact that the drag rod is straight, it remains to be said that the steering equipment is protected in every way.

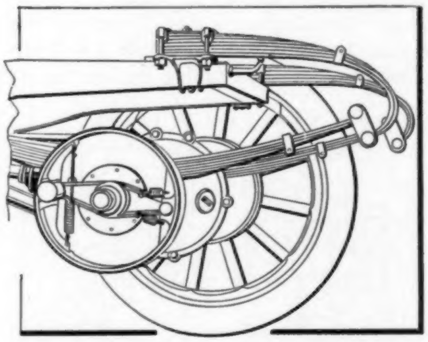


Fig. 9—Perspective of the live rear axle showing the braking mechanism and the shackling of the three-quarter elliptic springs

Referring to Fig. 8 of the live rear axle, the same being opened up at the differential housing separating its two parts H1 and H2, showing the bearings B1 and B2 to support the differential housing H3, the latter being removed with the bevel gear G1, thus indicating how the axle may be taken apart for inspection or repair if the occasion requires. The brake drums D1 and D2 are of pressed steel and large diameter, and the brake-rods R1 and R2 are supported in bearings on brackets B3 and B4. The tube is of substantial design and construction, notwithstanding which fact a jackstay is placed on the under side with a turnbuckle in its length for the purpose of relieving the tube of undue work. Fig. 9 shows the rear axle in perspective with one wheel off, admitting of examining the inside of the braking mechanism, and in this view the method of securing and shackling the three-quarter elliptic springs is also indicated.

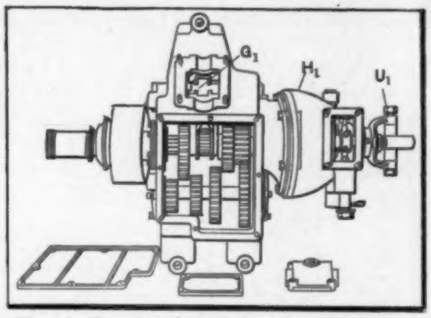


Fig. 6—Transmission gear with clutch combined with the cover off showing details

Some of the Remaining Considerations Apropos of This Model of Car.

The length of the wheelbase is 110 inches and the tread is 56 inches. The wheels are provided with 34 x 3 1-2-inch tires all around. The wheels are of the artillery type with 10 hickory spokes in the front and 12 like spokes in the rear wheels. The rims are of the quick detachable type. The side frames are of the channel section with a single drop. Two sets of brakes are employed, the service brakes being on the shaft of the external constricting type. The emergency brakes are in the drums on the rear wheels of the internal expanding type, and Raybestos is used as a lining throughout. The rear axle is of the full floating type, and the gear ratio is 3 3-4 to 1. The magneto is of the Bosch type. The carbureter is of the Mayer type, and the auxiliary air is heated by water.

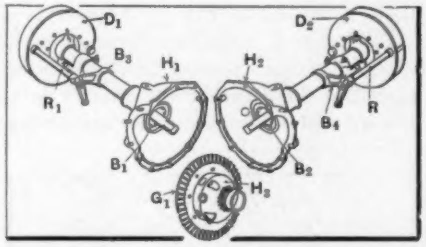


Fig. 8—Live rear axle disassembled showing details in the region of the differential

Java Becoming a Motoring Center—There are now several hundred automobilists in the Island of Java, about 500 machines having been imported into the Island in 1910. The Java Motor Club has the credit for accomplishing splendid work in the matter of establishing gasoline depots in several sections of the Island.

How Marathon Autmobile Is Made

Product of a Plant at Nashville, Tenn.

Of the industries in the South, the making of automobiles is not the leader, but the fact remains that the quality of the cars produced there bespeaks a measure of care, and that thoughtful consideration which would indicate to the keen observer that the requirements in view of the Southern road conditions are being effectively studied out, and the story here shows how the Marathon car, which is the product of one of the best equipped factories in the South, was designed to fit this environment.

FROM the art point of view, the Marathon automobile, as made by the Southern Motor Works, of Nashville, Tenn., is shown in Fig. 1, which is a three-quarter view. This particular model of car is of the conventional type with a touring body, and for those who express a preference for a torpedo type of automobile Fig. 2 will suffice to indicate what the maker has to furnish. In addition to these models the torpedo roadster, as depicted in Fig. 3, is a regular product of the company's plant.

The plan of the chassis of the 35-horsepower model car, which is used for all of the models that are being discussed

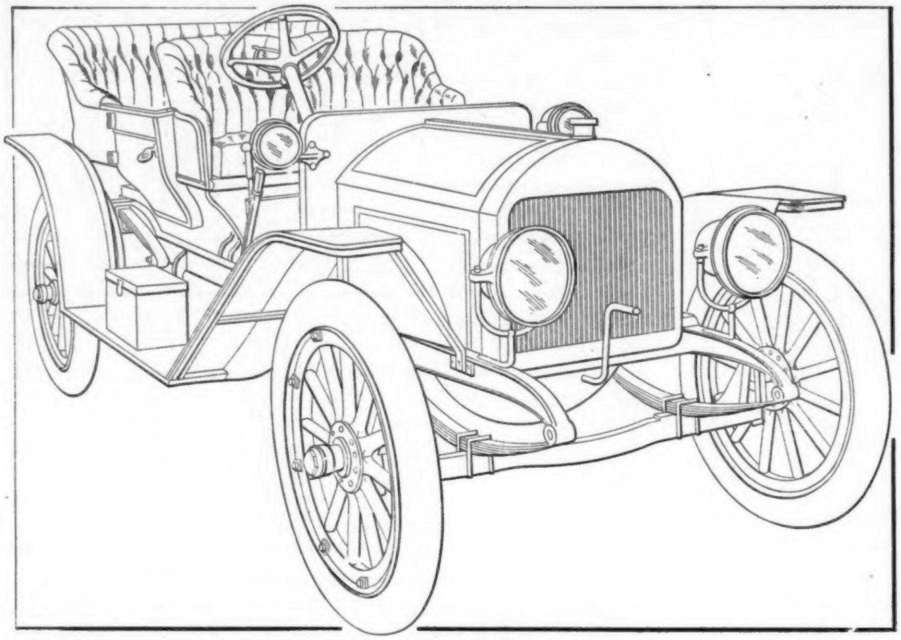


Fig. 1—Three-quarter view looking at the front of the Marathon conventional type of touring car

here, is shown in Fig. 4, wherein it will be seen that a unit power plant is suspended between the side-bars, the latter being of the channel section and stoutly shaped. The radiator is placed in the plane of the front axle and the propeller shaft is housed within a torsion tube, and among the other characteristics mention is made of full-elliptic (scroll) springs for the rear suspension, and it will be seen that half-elliptic springs are placed to carry the load at the front end of the automobile. To get an idea of the live rear axle unit it will be necessary to look at Fig. 5, and the details of the I-section front axle are clearly depicted in Fig. 6, which is a rear view, indicating the cross-rod C1 in its position back of the axle, and attention is called to the fact that the drop of the axle is lower than the cross-rod so that road obstructions may not strain the steering mechanism.

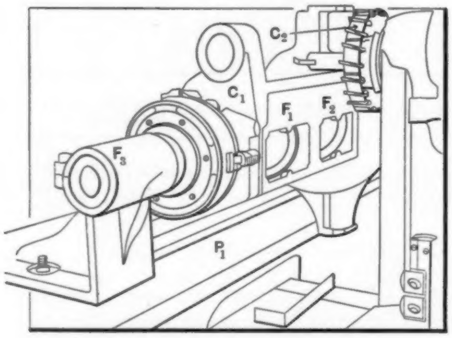


Fig. 10—Showing a process in the shop-milling of the crankcase on a basis of speed and accuracy

Confining attention to the 35-horsepower unit type of motor, as it is shown in Fig. 7, looking at the right-hand side of the same, it will be seen that the cylinders are cast in pairs, the bore being 4 1-4 inches and the stroke 4 1-2 inches, so that the four-cylinder water-cooled motor is given a fair rating of 35 horsepower by the company. The ignition includes a Remy magneto M2, which is fastened to a pad S1 by a yoke Y1, and is driven by a shaft with a gear in the housing H1, but the shaft passes through to the front of the housing and is provided with a pulley at the extremity, which takes the belt P1, furnishing power to the air propeller F1. The carbureter C1 is placed back of the magneto on the same side of the motor and the manifold M1 is curved toward the center of the motor as it passes upward, terminating in branches B1 and B2, leading to the pairs of cylinders of the motor and the manifold fastenings B3 and B4 which are in the form of yokes, in addition to holding the intake manifold as referred to, fastens the exhaust manifold E1 into place as a common effort. The motor is suspended at three points and the arm reaching across between the side-bars is faced off at F1 on each side to fit a similar pad on the side-bars. This arm is in the plane of the flywheel, which is within the housing H3, and the transmission gear is housed in the extension H2, which is flanged to the enlargement as shown. The pedals P2 and P3 extend out at the right side of the gear housing and the shaft for these pedals has an outboard support as well as taking its bearing in the extension H2.

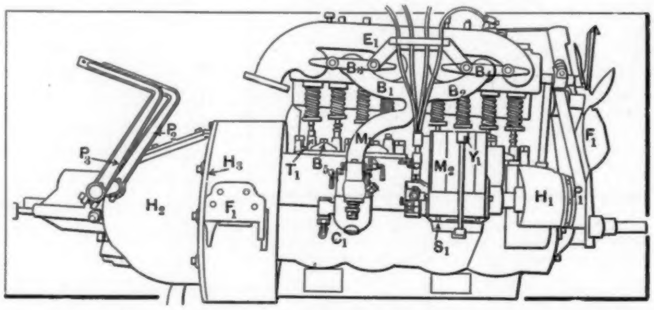


Fig. 7—Right-hand side of the unit type of power plant showing the location of the magneto and carbureter

The left-hand side of the motor is shown in Fig. 8, indicating that the cylinders are of the L-type, so that this side of the motor is clean, leaving nothing but the water connection W1 to take up room, thus making it desirable to put hand-hole covers C1 and C2 in the crankcase C3, which, together with the hand-hole cover C4 in the top of the transmission gearcase, affords communication to the working parts of the power plant for the purpose of inspection, cleaning, or repairing. The cooling is done on the thermo-syphon plan and the manifold W2 for the water placed on the top of the cylinders is made with a large area of the opening to facilitate the flow of water under the head that is induced by a mere difference in temperature utilized for circulation in this system.

The transmission gear is of the selective three-speed type, including the reverse, and the control by a side-lever is manipulated through a gate, the latter being placed outside of the body line, but in the torpedo models, as shown in Fig. 2, the body is curved outward, causing the control levers to fall within the line of the side thereof.

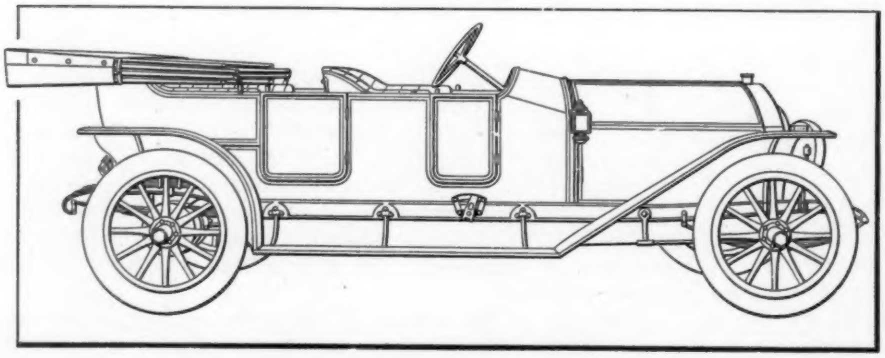


Fig. 2—Side elevation of the torpedo type of touring car, fitted with a top

Two distance rods are fitted beneath the spring perches of the rear axle and terminate as shown in Fig. 4 at the point where the propeller shaft leaves the gear box. The gear shifting arms will also be noticed one on either side of the housing. The method of leading the exhaust through the manifold placed over the motor is unique.

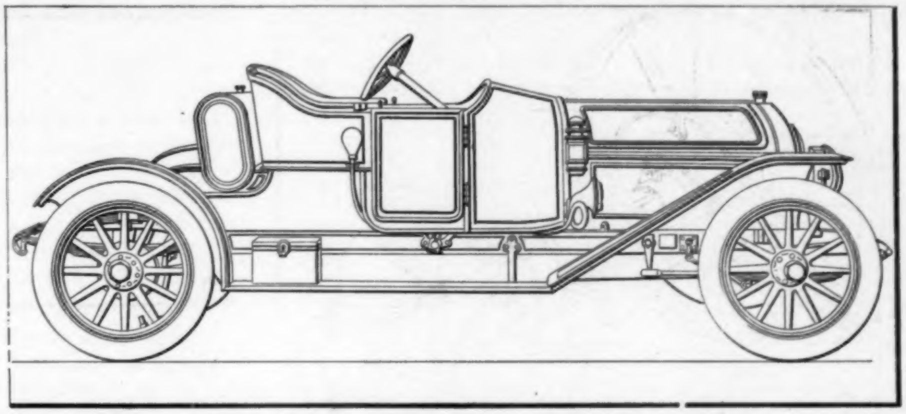


Fig. 3—Side elevation of the torpedo roadster, showing a foredoor and the gasoline tank back of the seat

Company's Plant Fitted Out to Handle Intricate Machining Operations Successfully

It will be understood that the building of automobiles when they are made in a plant at a considerable distance from the haunts of the makers of machine tools is more of an undertaking than would be ordinarily encountered, and in this effort the company recognized the limitations in the South from the machine-tool point of view, and in order to protect its customers in the matter of replacements, and in other ways, the plant has been fitted out with a special line of machine tools that were designed for interchangeable and rapid work, making it possible to accomplish the various tasks expeditiously and within allowable limits of tolerance. As an example of the design methods involved and the machining processes that have to be carried out, reference is made to the crankcase C1, as shown in Fig. 10, which is being

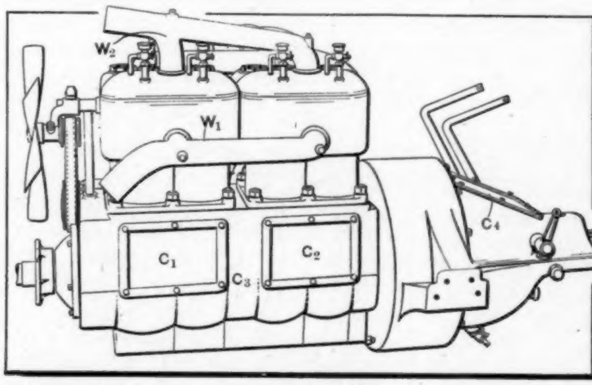


Fig. 8—Left-hand side of the motor indicating the hand-holes with covers

faced at F1, F2, etc., but the cat-head C2 in a commodious form of milling machine with a traveling platen P1, with a fixture F3, by means of which the work is centered with accuracy and without loss of time. Fig. 11 shows another example of designing, with faces F1 and F2, and the finishing of the bore at B1, B2 and B3, all in one setting, thus assuring a commercial product at a reasonable cost, and it is in the correlating of the scheme of design of the parts that go to make the automobile with the special forms of machine tools that are used for the purpose that makes this effort praiseworthy.

A Few of the Remaining Considerations from the Purchaser's Point of View

The standard wheelbase length of these cars is 116 inches, and the tread is 56 inches. The tire equipment is 34 x 3 1-2 inches all around. The gear ratio is 4 to 1, or 3 1-2 to 1. The clutch is of the multiple disc type nested in the flywheel, and Fig. 9 shows the assembling of the same, and the three clutch springs which are placed to maintain pressure during operation, the clutch being released by the mechanism, which is clearly brought into view. Control for the spark and throttle is located on the top of the steering column.

South for Good Roads

Throughout the South the spirit of advancement is apparent in the activity displayed for good roads. At the recent National Good Roads Congress at Birmingham, one speaker said that the Civil War could have been averted had it been possible to hold such a gathering fifty years ago.

TREMENDOUS progress in road making has been achieved throughout the South during the past year, and such highways as were traversed by Glidden Trophy tour of 1910 would be hard to find to-day. At the recently adjourned National Good Roads Congress, held at Birmingham, Ala., there were in attendance 1,364 delegates, representing seventeen States and the District of Columbia, besides fifty-eight women delegates from four active societies.

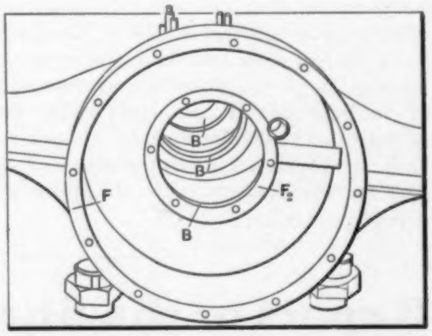


Fig. 11—Looking into the housing in the live rear axle, showing the scheme of design

Among those present were a number of Southern statesmen, including Governor O'Neal, Senator Bankhead and a dozen Congressmen. One striking utterance in the speech of Congressman J. I. Burnett, who treated of "National Aid for

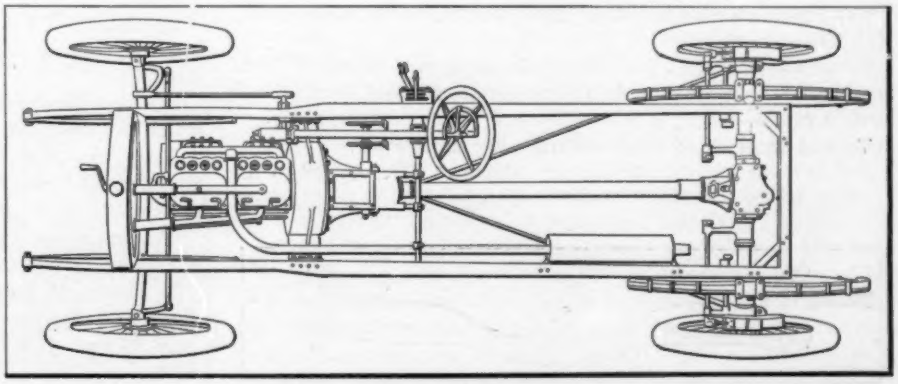


Fig. 4—Plan of the chassis showing the 35-horsepower unit type of motor resting on the sidebars

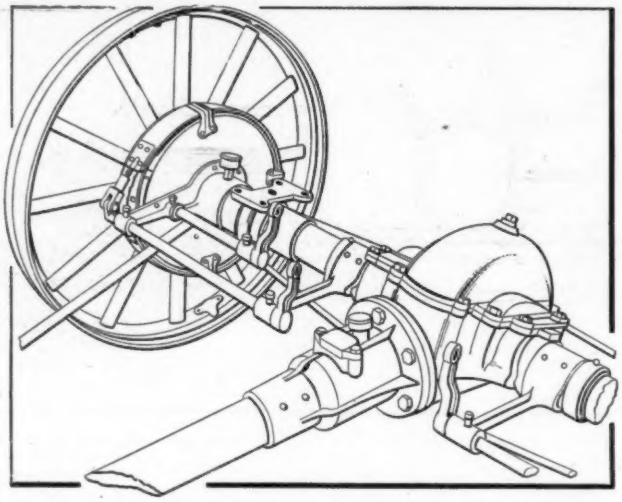


Fig. 5—Details of the Marathon live rear axle showing the fastening of the torsion tube housing the propeller shaft

Good Roads," was to this effect: He said that if such a meeting as the one he was addressing had been possible fifty years ago there would have been no Civil War.

While the South has taken the subject of highways very seriously in recent months, there is still room for a vast activity in that direction despite the progress that has been made. Undoubtedly such meetings as the one at Birmingham serve a useful purpose in fostering the spirit of advancement.

Representative Richmond Pearson Hobson read a draft of a bill to the delegates which he proposes to introduce into the next session of the National Congress. This bill provides for a general survey of the roads of the United States under the supervision of the Secretary of Agriculture; that the Director of Public Roads be authorized to co-operate with road officers of States and localities to make detailed surveys on a 50 per cent. basis for the Federal Government, and appropriating $100,000 a year for five years to take care of the government's end of the expense.

Report of the Sheet Metals Division

Being the recommendations of the Sheet Metals Division of the Standards Committee of the Society of Automobile Engineers, as of date of June, 1911. This report considers steels only, the other metals being reserved for a future report.

THIS report of the Sheet Metals Division is confined to steels. The subject of aluminum, copper, brass and alloys will be taken up in a further report.

The report on steel has been considered under two main heads, viz.: Sheets and Strips.

SHEETS—Sheet steel for automobile parts may be rolled from low carbon Bessemer steel or low carbon open-hearth steel (either acid or basic).

Typical analyses of these materials are as follows:

	Carbon	.08 to .12
	Silicon	Under .02
Low carbon Bessemer steel	Sulphur	Under .07
	Phosphorus	Not over .10
	Manganese	.30 to .50
	Carbon	.08 to .18
Low carbon, open hearth (Basic)	Sulphur	Not over .04
	Phosphorus	Not over .04
	Manganese	.40 to .60
	Carbon	.10 to .15
	Silicon	Under .02
Low carbon, open hearth (Acid)	Sulphur	Under .06
	Phosphorus	Under .08
	Manganese	.30 to .50

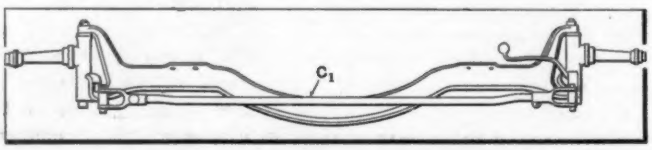


Fig. 6—Marathon I-section front axle looking at the back of the same, showing the position of the cross rod

(For deep drawing or difficult forming basic open hearth should be specified.)

GAUGE—The accepted gauge of the sheet steel industry is the United States Standard Gauge, a copy of which appears in S. A. E. data sheet form. It is recommended when writing specifications for sheets that the thickness desired be expressed in thousandths of an inch. It should be noted that this standard was made to cover iron and steel. The weight per square foot for the various gauges and thicknesses is correct for iron, while the weight of steel for the same thickness is 2 per cent. heavier.

VARIATIONS IN THICKNESS—In regular practice sheets lighter than No. 16 are considered to be a commercial delivery if the weight per square is within 2½ per cent. of the standard weight, either above or below. For sheets No. 16 and heavier a commercial delivery consists of sheets which are within 5 per cent. of the standard weight, either above or below. Variations in thickness occur between sheets, and also between different points in the same sheet, due to slight inequalities of temperature of steel, changes in contour of rolls and spring of machinery.

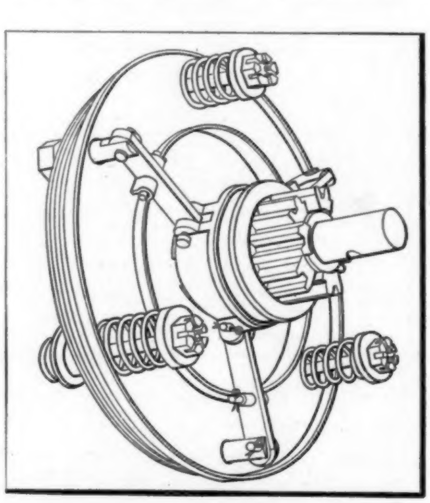


Fig. 9—Assembly of the clutch showing the fastening of the three springs and the toggle

A reasonable variation in thickness may be considered as 6 per cent. above or below the specified thickness for sheets No. 11 or heavier. From No. 12 to No. 18 gauge a reasonable variation will be 8 per cent. above or below the specified thickness. In sheets thinner than No. 18 gauge the percentage of variation will be liable to increase as the thickness decreases. In sheets of all gauges the variation in thickness will increase as the width and length increase.

Specifications for sheets for cold drawing should indicate the greatest possible variation from the mean thickness that is permissible.

FINISH—Sheet steel is made in a variety of finishes, some of which are described in the following paragraphs:

BLUE ANNEALED SHEETS—These sheets are hot rolled and open annealed and are furnished in gauges No. 16 and heavier, in dimensions up to 48" wide and 144" long.

This treatment preserves the integrity of the steel and sheets of this grade are suitable for pressing and cold drawing purposes.

If sheets are required to be free from the mill scale or oxide formed during the rolling and annealing processes, this requirement is met with least injury to the steel by means of a sand blast.

Pickling in dilute sulphuric acid is commonly resorted to for the purpose of dissolving the scale, but, as this process has a

tendency to produce brittleness unless followed by an annealing process, it should be avoided as far as possible.

ONE PASS COLD ROLLED AND BOX ANNEALED SHEETS—These sheets are hot rolled, cold rolled one pass to take out creases and buckles, and annealed in an air-tight box or cover.

This treatment is suitable for sheets lighter than No. 16 gauge, which are not required to have a specially smooth surface.

FULL COLD ROLLED AND RE-ANNEALED SHEETS—Sheets are hot rolled, annealed, cold rolled three or more passes and re-annealed.

This treatment gives a smooth sheet with as good a surface as is procurable in the presence of the oxide formed in heating and rolling.

PICKLED FINISHED SHEETS—These sheets are hot rolled, annealed, pickled, full cold rolled and re-annealed.

This treatment gives a smooth sheet, free from scale and oxide, but liable to be pitted owing to the presence of scale on the steel bar.

FULL PICKLED FINISHED SHEETS—These sheets are made from pickled bars or are pickled after first stage of rolling, subsequently finished on hot mills, annealed, pickled, full cold rolled and re-annealed.

This treatment produces a clean, smooth sheet free from scale and heavy scale marks or pits.

This material is suitable for hoods and fenders, and when patent leveled may be used for bodies if a proper filler is used to close up the small pits.

Sheets of the foregoing are furnished in gauges No. 16 to No. 30, and in sizes up to 36" wide and 120" long.

AUTOMOBILE BODY STOCK—These sheets are made in the same way as the full pickled finished sheets but are patent leveled and resquared, and are subjected to a close inspection for pit marks. One side of each sheet should be free from pits.

These sheets are made in gauge No. 20 and No. 22 and in sizes up to 36" wide and 120" long.

GALVANIZED SHEETS—Sheets of steel, properly prepared and coated with zinc by being passed through a molten bath of this metal.

The weight per square foot is 2½ oz. heavier than the weight of the corresponding gauge in uncoated sheets.

Galvanized sheets can be obtained in gauges from No. 21 to No. 30, in sizes up to 36" wide and 120" long; and in gauges from No. 10 to No. 20, in sizes up to 48" wide and 144" long.

LONG TERNE SHEETS—Sheets of steel coated with an alloy of lead and tin.

These sheets can be obtained in gauges from No. 20 to No. 30, from 20" to 40" wide and up to 120" long.

STRIPS—Sheets narrower than 20" are variously designated bands, hoops and strips, these terms being applied arbitrarily to those flat sections of finished sheet which are rolled in long lengths and in widths narrower than sheets and plates, and in thickness lighter than bars, and can be secured in either cold or hot rolled finish.

HOT ROLLED STRIP—Flats No. 12 (=.109") and heavier up to 6" wide are usually termed "bands."

Flats No. 12 (=.109") and heavier wider than 6" are termed "band edged flats" and are classed as plate.

Flats No. 13 (=.095") and lighter are termed "hoops" or "strips."

Flats which are rolled for the purpose of being subsequently finished into pipe or tubes are termed "skelp."

The name of "skelp" is never correctly given to finished steel strip.

The material commonly used for rolling into bands, hoops and strips is low carbon steel, made either by the Bessemer or Basic Open-hearth process. Typical analyses of steel made by these processes were given under the heading of "Sheets."

GAUGE—The gauge used by the manufacturers of bands, hoops and strips is the Birmingham Wire Gauge, a copy of which appears in the S. A. E. data sheet form.

It is recommended when writing specifications for bands, hoops and strips that the thickness desired be expressed in thousandths of an inch.

STANDARD WIDTHS AND GAUGES—Bands, band edged flats and hoops or strips are rolled in the following standard widths and gauges:

		Width.	Thickness.		
		3/8"	No. 4 = .238"	to	No. 18 = .049"
		7/16"	" 4 = .238"	"	" 19 = .042"
1/2"	increasing by 1/16ths to	1"	" 4 = .238"	"	" 23 = .025"
1 1/16"	" " " "	2"	" 4 = .238"	"	" 22 = .028"
2 1/16"	" " " "	3"	" 1 = .300"	"	" 21 = .032"
3 1/16"	" " " "	4"	" 1 = .300"	"	" 20 = .035"
4 1/16"	" " " "	4 1/2"	" 1 = .300"	"	" 19 = .042"
4 9/16"	" " " "	4 3/4"	" 00 = .380"	"	" 18 = .049"
4 3/16"	" " " "	5 1/16"	" 00 = .380"	"	" 17 = .058"
5 1/8"	" " " "	6 3/4"	" 00 = .380"	"	" 16 = .065"
		7"	" 1 = .300"	"	" 14 = .083"
		7 1/2"	" 1 = .300"	"	" 14 = .083"
		7 5/8"	" 1 = .300"	"	" 14 = .083"
		7 3/4"	" 1 = .300"	"	" 14 = .083"
		7 7/8"	" 1 = .300"	"	" 14 = .083"
		8"	" 1 = .300"	"	" 14 = .083"
		8 1/4"	" 1 = .300"	"	" 14 = .083"
		8 1/2"	" 1 = .300"	"	" 14 = .083"
		8 5/8"	" 1 = .300"	"	" 14 = .083"
		9 5/8"	" 1 = .300"	"	" 12 = .109"

While above sizes are generally considered standard, the majority of mills roll strips as wide as 20" in the heavier gauges.

COLD ROLLED STRIP—Under this head is found the product of mills, cold rolling strips, bars and sheets, for use principally in stamping and forming operations where more accuracy of gauge is required than is furnished by hot rolled mills. It is also used where a maximum of ductility or finish is essential.

Cold rolled strip is furnished in widths ⅜" to 15" inclusive and in gauges from .003" to ¼", it being understood in general practice that the thickness shall be not less than one-half of one per cent. of the width.

Where dies are expensive to construct and maintain, steel entirely free from scale and bright-rolled to uniform gauge must be used, as a matter of manufacturing economy.

In this class, as in the others, engineers should be careful to state the results to be obtained from the steel and advise the mills of the variations which can be allowed.

(Signed) JAMES H. FOSTER, Chairman.
A. R. GORMULLY
ROBERT SKEMP
T. V. BUCKWALTER
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L. R. SMITH
C. E. LOZIER
H. P. DAVIS

Report of the Broaches Division

Being an outline of the results of the work the Broaches Division of the Standards Committee of the Society of Automobile Engineers, and bearing date of June, 1911, the same being a preliminary report and for discussion only.

WE herewith submit the results obtained by careful consideration of correspondence and conference between the members of the Broaches Division and of consideration of a tabulation of exhaustive data collected by the Society's office, showing the practice of the S. A. E. members as to multiple spline shafts and square shafts.

MULTIPLE SPLINE SHAFTS—We give herewith Table No. 1 in connection with multiple spline shafts. The first formula therein appearing is worked out for the fit to be made to the reamed or ground portion of the shaft between the splines, and the hole to be ground concentric with the pitch line of the gear.

The second formula appearing in Table No. 1 applies to fit to be made to the outside diameter of the splines. The hole is not to be ground but to be left as broached. Both of the formulae cover four or six grooves. We do not recommend the adoption of an odd number, on account of the difficulty of calipering either the shaft at the bottom of the groove or the shaft or top of the splines or the hole diameter. We recommend the second formula for adoption as standard.

TABLE No. 1—MULTIPLE SPLINE SHAFTS (4 AND 6 SPLINES).
Fit to Come on Shaft at Bottom.

.006 allowed for grinding in hole of gears.
"b" Outside diameter shaft.
"a" Bottom diameter shaft.
"w" Width of key.
"f" = Radius at corners of keys and fillet.

$$\text{"b"} = a + w + 2f$$

$$\text{"w"} = a \times r$$

"r" = .24 ratio assumed.

$$\text{"f"} = \frac{a}{50}$$

"a"	"b"	"w"	"f"	Shaft Size.	
.994	1.280	.240	.020	1	1.25
1.119	1.441	.270	.023	1.125	1.40625
1.244	1.600	.300	.025	1.250	1.5625
1.369	1.750	.330	.027	1.375	1.71875
1.494	1.920	.360	.030	1.500	1.875
1.744	2.240	.420	.035	1.750	2.1875
1.994	2.560	.480	.040	2.000	2.500
2.244	2.850	.510	.045	2.250	2.8125
2.494	3.200	.600	.050	2.500	3.125
2.744	3.250	.660	.055	2.750	3.4375
2.994	3.840	.720	.060	3.000	3.750

MULTIPLE SPLINE SHAFTS (4 AND 6 SPLINES).
Fit to Come on Outside Diameter of Splints.

$$\text{"a"} = b - (w - \frac{5f}{2})$$

$$\text{"w"} = b \times r$$

$$\text{"f"} = \frac{w}{15}$$

TABLE 2.—SHORT DIAMETER SIZES RECOMMENDED.

.80 RATIO		.73 RATIO	
Short Diameter.	Long Diameter.	Short Diameter.	Long Diameter.
1/4	5/16	1/4	11/32
3/8	15/32	3/8	33/64
1/2	5/8	1/2	11/16
5/8	31/32	5/8	27/32
3/4	15/16	3/4	1 1/32
7/8	1 1/16	7/8	1 3/16
1	1 1/4	1	1 3/8
1 1/8	1 3/8	1 1/8	1 9/16
1 1/4	1 5/8	1 1/4	1 11/16
1 3/8	1 11/16	1 3/8	1 7/8
1 1/2	1 7/8	1 1/2	2 1/16
1 3/4	1 3/16	1 3/4	2 3/8
2	2 1/2	2	2 3/4
2 1/4	2 13/16	2 1/4	3 1/16
2 1/2	3 1/8	2 1/2	3 7/16
2 3/4	3 3/8	2 3/4	3 3/4
3	3 3/4	3	4 1/8
3 1/2	4 3/8	3 1/2	4 3/4
4	5	4	5 1/2

SQUARE SHAFTS.—It is the consensus of opinion of the division that we hold to one size to make the hole standard and the same size square for both sliding and fixed fits as far as the hole goes.

In our judgment, .8 will give satisfactory results for fixed and sliding fits. On sliding fits under very heavy duty this ratio will have to be carried to .73, using in both instances even fractional dimensions.

In regard to short diameter sizes to be established: same to vary by ⅛ in. from ¼ in. to 1½ in.; by ¼ in. from 1½ in. to 3 in.; and ½ in. for 3 in. and above.

DIMENSIONS OF SPLINE SHAFTS.

"a"	"b"	"w"	"f"	Hole Size	
1	1.250	.300	.020	1.000	1.250
1.125	1.40625	.3375	.0225	1.125	1.40625
1.250	1.5625	.375	.025	1.250	1.5625
1.375	1.1875	.4125	.0275	1.375	1.71875
1.500	1.875	.450	.030	1.500	1.875
1.750	2.1875	.525	.035	1.750	2.1875
2.000	2.500	.600	.040	2.000	2.050
2.250	2.8125	.675	.045	2.250	2.8125
2.500	3.125	.750	.050	2.500	3.125
2.750	3.4375	.825	.055	2.750	3.4375
3.000	3.750	.900	.060	3.000	3.750

WORKING LIMITS.

Splined Shafts.

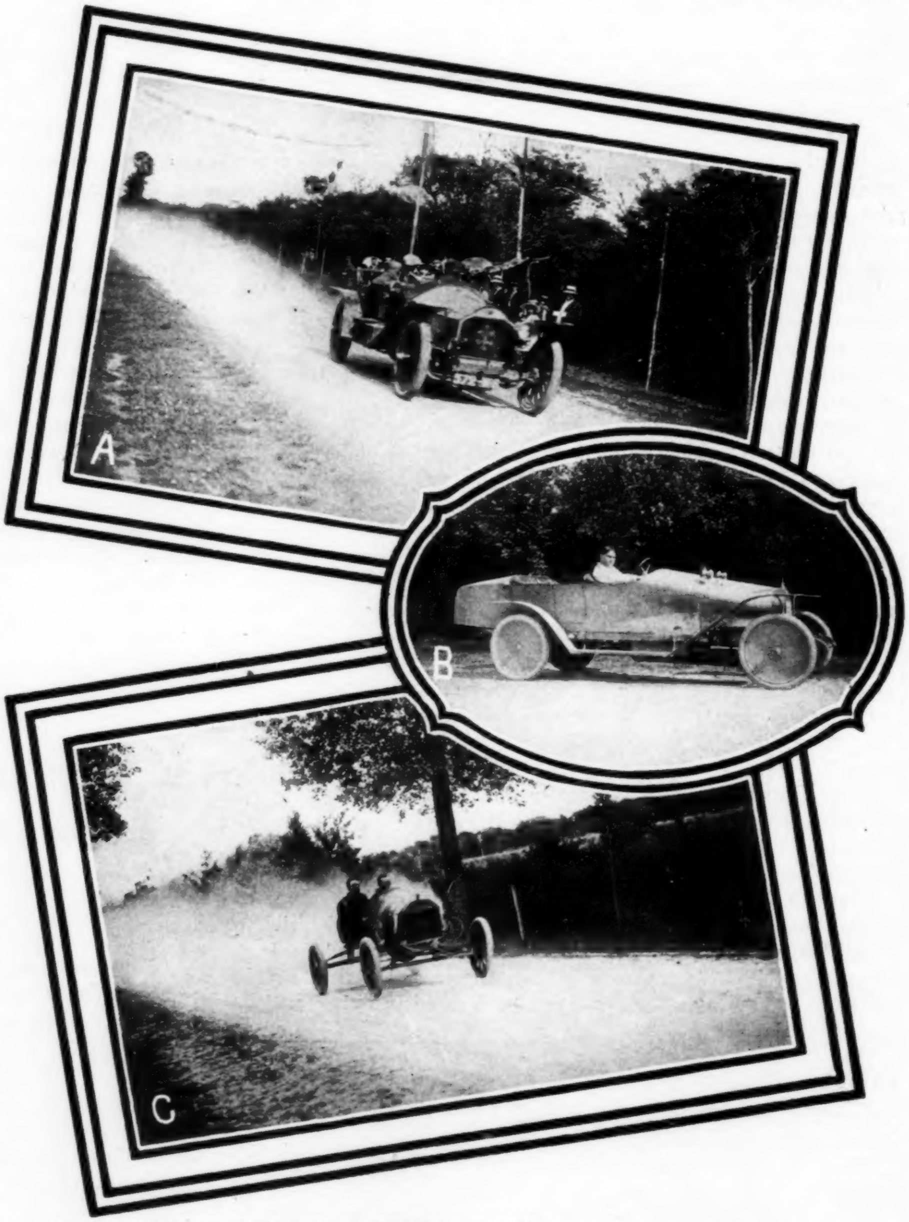
Shafts up to 1½" diam.	from .0005 to .002 under	from Std. to .001 over
" " 2" "	" .001 " .002¾ "	" " " .001¼ "
" " 3" "	" .001½ " .003½ "	" " " .001½ "
" " 3¾" "	" .002 " .004¼ "	" " " .001¾ "

Splined Shaft Keys.

Shafts up to 1" diam.	from .001 to .003 under	from Std. to .005 over
" " 2" "	" .002 " .004 "	" " " .006 "
" " 3" "	" .003 " .005 "	" " " .007 "
" " 3¼" "	" .003 " .005 "	" " " .007 "

Square Shafts.

Shafts up to ¾" diam.	from .000¼ to .001¼ und.	*On soft work up to 2".*
" " 1" "	" .000½ " .001½ "	from Std. to .001 under.
" " 2" "	" .000¾ " .002 "	*On hardened work*
" " 3" "	" .001 " .002¼ "	Standard + or — .001



A—Lorraine-DeDietrich at the start of the kilometer trial
B—Streamer body with tail attachment for overcoming wind resistance
C—Ford car that won its class in the kilometer and hill climb

DRIVING LIMITS FOR FITS.

Square Shafts.

Shafts up to ¾" diam.	from .001½ to .002 over	from Std. to .000¾ over
" " 1" "	" .002 " .003 "	" " " .001 "
" " 2" "	" .002½ " .003½ "	" " " .001¼ "
" " 3" "	" .003 " .004 "	" .000½ " .001½ "

(Signed)

C. E. DAVIS, *Chairman.*
C. W. SPICER.
J. N. LAPOINTE.
F. L. EBERHARDT.
G. E. MERRYWEATHER.
COKER F. CLARKSON, *Secretary.*

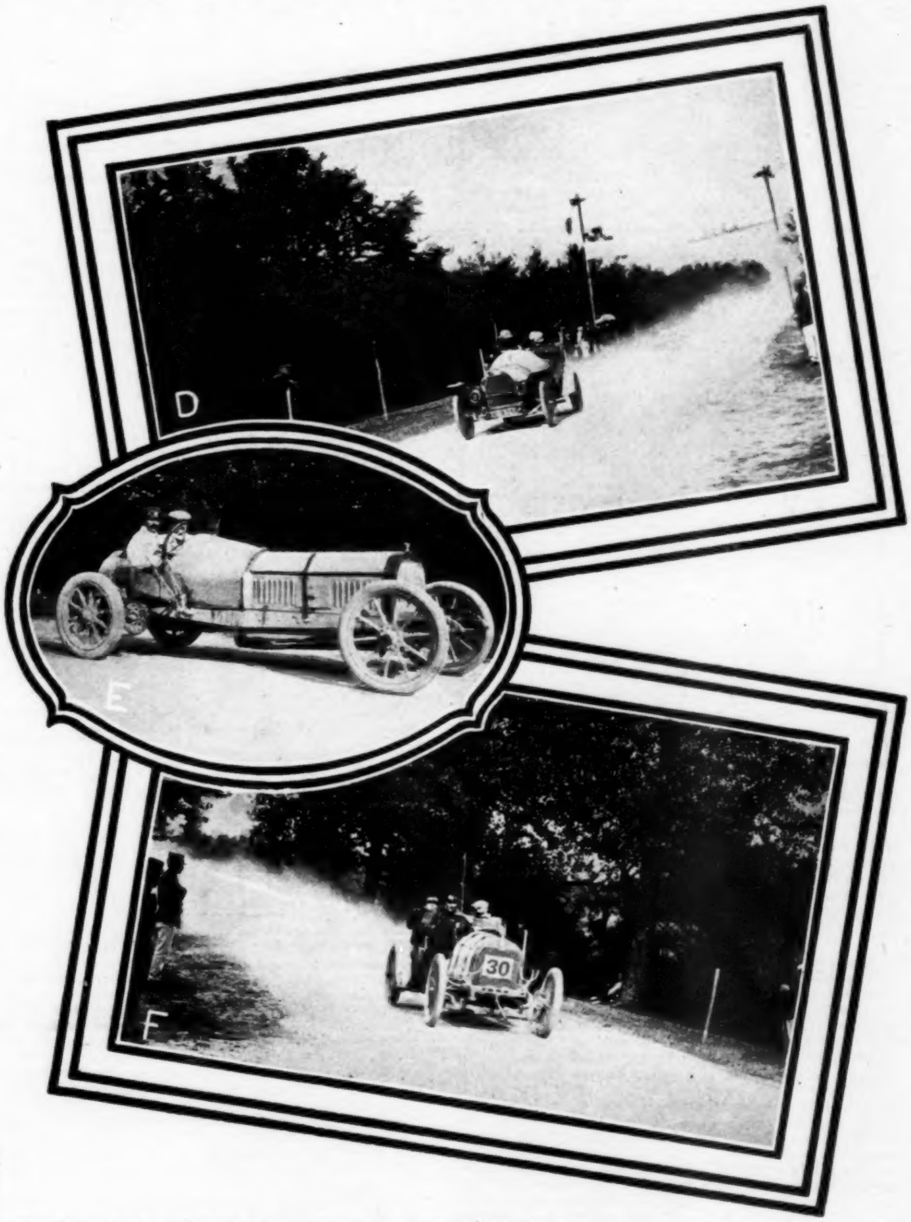
French in Racing Throes

There is a noted lack of enthusiasm on the part of manufacturers to enter cars in the big races on the other side, but the small car events seem to be well supported. This is probably due to the decline of the large car and the better efficiency of the light small four-cylinder. With the price of gasoline high in France and the taxation according to horsepower in England, this is hardly to be wondered at.

UP to date the entries for the Coupe des Voiturettes, to be held over the Boulogne sur Mer course, number 44, including entrants from France, Germany, America, Italy, Belgium, England and Scotland. The American entrant is the Ford, driven by the French agent himself. England is paying much attention this year to the French market, which would seem to be a case of carrying the war into the enemy's camp. The English contingent will be represented by the Calthorpes, three Arrol-Johnstons, one Sunbeam and one Vauxhall. The Calthorpe cars have been regular entrants in this race, but apart from consistent running one year, have not had the best of luck. The Arrol-Johnston cars are made in Scotland, and it was a car of this make with a horizontal engine that won the first Tourist trophy race in the Isle of Man in 1906. The Sunbeam and Vauxhall cars are by no means new to the racing game, and their list of successes at Brooklands makes them dangerous adversaries. It may seem curious to see drivers whom one associates with big cars—Hemery, Duray Wagner, Bablot and Regal et al.—at the wheels of cars with a 3 1-2 inch bore, but when it is considered that last year's race was won at a speed of over 50 miles per hour the best and most experienced drivers are none too good.

There is a large amount of independence in the running of races in France, and the entries for the large car races over the Sarthe course have been very tardy, which means that unless other makers put in their entries before long there is a chance of some of those who have already entered withdrawing, which will spell fiasco. French makers have not gone into the matter wholeheartedly, and, apart from the voiturette event, racing seems to be on the decline. In some quarters this seems to be due to failure on the part of the promoters to make use of publicity. The Automobile Club de la Sarthe recently organized a kilometer trial and a hill climb near Le Mans, the start of the Grand Prix de France. The course was over superb roads, as may be seen in the accompanying illustrations.

The kilometer trial was held at Fresnay sur Sarthe, and the Ford car entered in the Grand Prix Voiturette race covered the measured distance in 32 2-5 seconds, winning in its class. The Rossel car shown at (E) made the fastest time of the day in the racing car class. It served to show the running of the Rolland Pilain cars, which also won their class. These cars are entered in the Grand Prix. The time for these cars was 33 4-5 seconds. In order to give the contestants time to prepare for the big race at Le Mans the date of the Sarthe races has been postponed to the 9th of July, the Boulogne meet taking place on the 25th of June. The body design shown at (B) is becoming de rigueur in Continental contests to overcome wind resistance.



D—General view of the start, showing the excellence of the roads
E—Rossel car, winner of speed and hill climb, making fastest time
F—Rolland Pilain, entered in the Grand Prix, winner of its class

The Trend of Events

POINTS to a better understanding of the relation of roads to automobiles—it is possible to foresee the day when good automobiles will be conserved by equally well-made roads.

POINTS to the use of properly treated steel, but this will not be the ground for laying the foundation of the structure of initially inferior steel.

POINTS to the employment of body-work that will co-relate to the chassis design and construction more closely than the indications are of the work of those who prolong the carriage makers' art.

POINTS to the use of leather in the upholstery that will not "crock" and soil the frocks of the ladies who recline on the cushions and rest against the backs of the seats.

POINTS to the tire problem, and to the fact that there is a well-balanced relation between diameter and section of tires.

Meeting Recurring Troubles

Presenting a Series of the Most Probable Cases

A series of correlated short stories, accompanied by diagrams and characteristic illustrations, including the nature of the troubles that are most likely to happen to automobiles, discussing their causes and effects, all for the purpose of arriving at a remedy. It is the aim, for the most part, to show how these troubles may be permanently remedied, and as a secondary enterprise it is indicated how the automobilist can make a temporary repair, thereby enabling him to defer the making of a permanent repair until a convenient time arrives.

Oiling Problems.—The lubrication problem of automobiles has been simplified considerably in the last few years, and it is becoming a matter that almost looks after itself. The average driver, be he owner or paid servant, on receipt of a new car should make it a point to study the lubrication system of the car before he attempts to drive it at all. When asking for information upon the subject it is no exaggeration that there are few who really know the points. Salesmen are seldom engineers, and the question of a pint of oil more or less does not materially interest them. Quite a large number of makers of cars issue an instruction book on how to run the car, and the general information to be gleaned is that the motor should have oil replenished every so many hundred miles. This is no better than the old-time method, where it was a matter of filling every 20 or 30 miles. One way to find out if the motor is getting sufficient oil is by seeing if the exhaust is smoky. There are a large number of drivers who only know this method, and it was not until the smoke nuisance in New York was taken up by the traffic squad that any abatement took place. The owner should find out from some person in authority in the firm from whom he buys the car the exact amount of oil that should be placed in the crankcase of the motor after this has been emptied and pay particular attention in the first few hundred miles of running to err on the side of over, rather than under lubrication. In the following series of short articles on the lubrications of different makes of cars the oiling system of each is given in detail, together with illustrations:

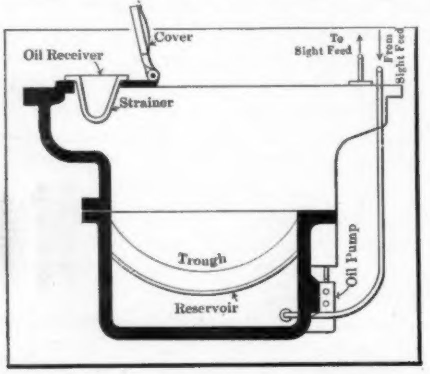


Fig. 1—Sectional end view of the Premier base chamber, showing the trough and the filler

Refinements of Premier Lubrication.—The Premier six-cylinder car is lubricated by the splash system. The base casting forms the oil reservoir, carrying the whole supply of oil. This base casting which is made of aluminum is divided into sections which form troughs besides lending lateral stiffness to the casting.

The bottom of the connecting rod has a small projection or "spoon" which scoops the oil up into the cylinder and over the rod bearings as a flying spray, lubricating the piston, connecting rod and camshaft.

The oil troughs are kept constantly full by means of a pipe running alongside of the crankcase. Oil is forced through this pipe by means of a gear-driven centrifugal pump which takes the oil from the reservoir at the rear of the base of the engine, forces it up through a sight feed which is located on the dashboard and from there it descends to the pipe running along the crankcase. This pipe is tapped for each oil trough, the overflow from the trough being drained back to the reservoir.

The oil is supplied to the system through an opening about 4 inches in diameter through one of the crankcase supporting arms; and the amount of oil in the system may be judged by means of a pet cock. A conical brass strainer is set in the opening by which the oil reservoir is supplied. About 1 gallon of oil is necessary for every 250 miles.

The bearing journals are pocketed. These pockets catch the oil and allow it to flow through oil holes into the bearings. The bearings on the car outside those of the engine are lubricated by means of oil cups and screw-down grease cups.

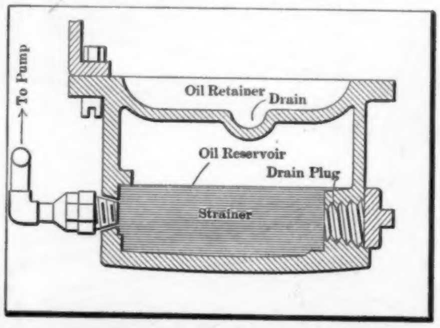


Fig. 3—Oil pan of the Hudson Motor, also showing the false bottom into which the connecting rods dip

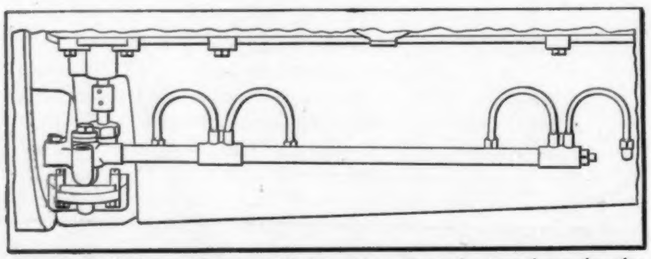


Fig. 2—Method used in the 1912 Premier to keep the troughs under the connecting rods full of oil

Splash System Is Used on Hudson Product.—The Hudson "33," four-cylinder machine is oiled by the splash system. The oil reservoir is located in the bottom of the crankcase casting, or, as it is often called, the oil pan of the motor. This reservoir has a capacity sufficient to lubricate the car, when driven at an average touring speed, for about a distance of 500 miles before replenishing.

When it becomes necessary to refill, the oil is poured into the breather pipe until the oil will flow from the oil gauge cock at the front end of the crank case oil well, on the right hand side of the motor.

The oil is pumped from the reservoir pipe to the sight feed on the dashboard. The oil is led into the top of this sight feed, through which the observer watches all the oil supplied by the pump, and then flows from the bottom of the sight feed back again to an opening into the crankcase near the pump opening.

At each revolution the bottom of the connecting rod is dashed into the oil, throwing up a sufficient quantity to lubricate the cylinder as well as the bearings.

The oil is kept at a constant level by means of troughs formed by walls of metal in the crank case. These walls are at such a height that the oil will overflow if too much is being supplied. This overflow runs back into the well beneath the crankcase, replenishing the supply in the reservoir.

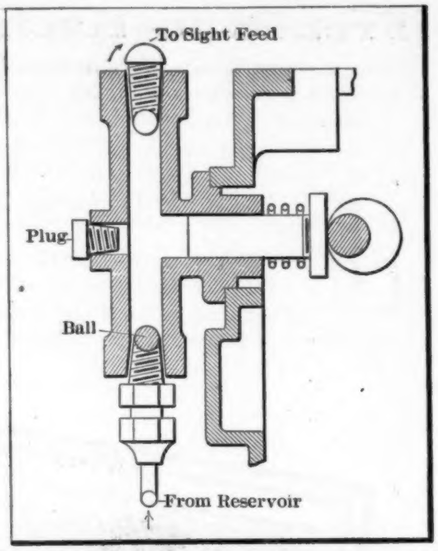


Fig. 4—Sectional view of the plunger pump used on the Hudson "33," showing the two ball check valves

The pump takes the oil again from this point after it has passed through a strainer and sends it through the system again. In passing through the motor a quantity of oil is lost by burning and by waste, this is made up by adding more oil through the breather and filler tube, which is located in the left-hand front foot of the motor.

The oil troughs are rounded to conform to the curve described by the bottom end of the connecting rod. This is somewhat elliptic in form due to its being described by a projection on the connecting rod.

The pump is driven off a shaft which runs laterally across the front of the motor not only driving the oil pump but the water pump and magneto as well. It is of the plunger type with two ball checks. There is a plug in the barrel of the pump to allow of its being cleaned should any foreign matter get beyond the strainer in the bottom of the reservoir.

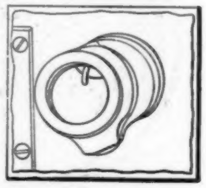


Fig. 6—Sight feed oiler as used on the dashboard of Cadillac cars

At the end of every 500 miles the oil is drained from the reservoir by means of a drain plug located in the bottom of the casting.

The other bearings are supplied with grease cups and the transmission, differentials and rear axle housings are packed in oil and grease.

How Oldsmobile "Autocrat" and "Limited" Are Oiled.—The Oldsmobile four-cylinder motors are lubricated by a combination of the force-feed and splash systems.

The oil reservoir is located in the lower part of a double-bottomed casting and slopes back to the rear of the motor until it is on about the same level as the bottom of the flywheel.

The capacity of the oil well is about three gallons. It is filled by means of a filler hole on the

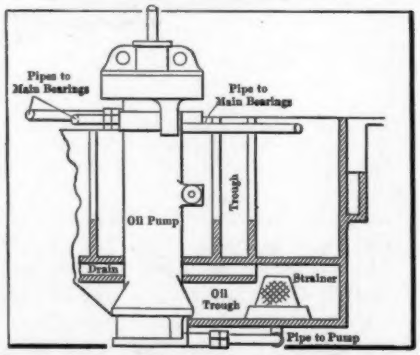


Fig. 5—Sectional side view of the Autocrat Oldsmobile, showing the troughs, strainer and the gear-driven oil pump

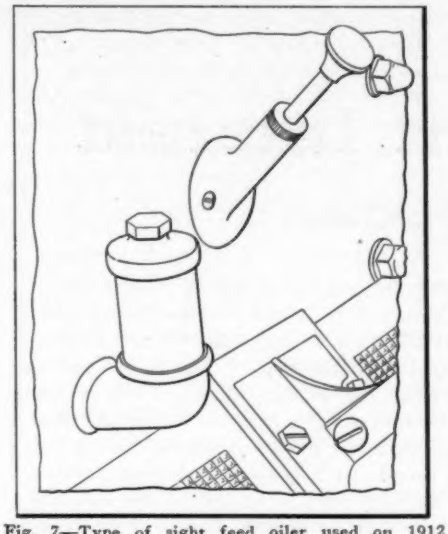


Fig. 7—Type of sight feed oiler used on 1912 Premier cars, located near the base of the steering pillar

left-hand side of the motor. This hole is covered by a brass cap. The oil is poured into the reservoir until the riser in the gauge glass, which is located alongside of the filler hole, shows a good height. This gauge glass is examined from time to time while running, the riser never being allowed to drop out of sight.

In the base of the reservoir there is an opening covered by a strainer. This opening leads to a tube through which the oil is drawn to a gear-driven pump operated by the exhaust camshaft.

This pump, which is of good capacity, takes the oil drawn from the reservoir and forces it through a pipe which entirely surrounds the crankcase. This pipe is tapped for leads to each main bearing, the camshaft bearings and the timing gears.

The connecting rod bearings and the cylinders are lubricated by splash. The inner bottom of the crankcase is provided with curved troughs which conform to the curve described by the connecting rods. The connecting rods dip into these troughs and beat the oil into a heavy spray which covers the interior of the cylinders and the bearings at either end of the connecting rod. The oil is kept constantly supplied to these troughs which are allowed to overflow. The overflow runs into the partitions between the troughs, which are drilled, allowing the oil to flow into a rectangular sectioned pipe which is a part of the inner bottom casting. This pipe leads back to the reservoir at the rear of the casting. From here the pump again draws it through the strainer and the force-feed system.

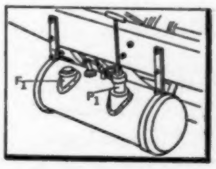


Fig. 8—Reserve oil tank located outside the chassis frame on the Lozier

There are four small oil holes located in the angles of the universal joint crosses, two in each cross, which must be frequently oiled with a squirt can.

There are grease cups located on the clutch hub, water pump and other bearings of the car which require the usual filling and occasional screwing down. The transmission case is either filled with heavy oil, a light grease or a mixture of both, and is kept at a level of about an inch over the top of the sliding bars. It is filled through a filler hole located in the small housing cap over the gear shifter finger. The propeller shaft universal joint is packed with heavy grease applied through an opening in the brass housing. The rear axle is filled with heavy oil or light grease, which is admitted by removing a small plug on the rear of the housing. Other bearings are supplied with small oil holes which require occasional attention from the operator and are generally oiled by means of a squirt can.

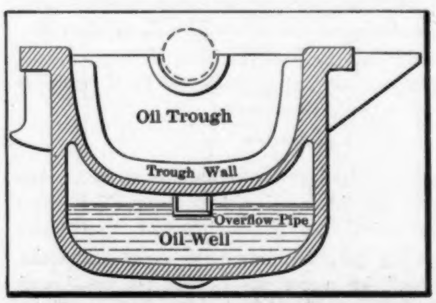


Fig. 9—Oil well and troughs used on the Oldsmobile cars, showing the overflow pipe

THE LOZIER OILING SYSTEM.—The Lozier cars are lubricated by the constant level splash system. The oil supply is carried in a reservoir located on the left-hand side of the car just inside the running board. The supply is supplementary to the oil carried in the crankcase or oil pan, and is just drawn upon sufficiently to replenish the supply of oil in the splash chambers.

The oil is drawn from the reserve tank and is supplied to the oil pan by means of a Pedersen slide-valve type pump. The advantage claimed for this pump is that there are no ball checks and the delicacy of adjustment possible. The pump itself is located in an almost cubical casing on the exhaust side of the motor at about the center of the engine. It is driven off the camshaft by means of a worm gear. The length of the stroke of the pump is changed by means of a set nut, which is located on the end of a vertical shaft in the center of the box. A small crank setting on the top of the pump casing furnishes a means of operating the pump by hand, thus bringing the oil rapidly up to its operating level in the oil pipes before starting the engine.

The pump draws the oil from the tank on the side of the car, up through a sight feed located on the dash and from there back to the crankcase.

The bottom casting of the engine is divided up into a series of compartments forming oil troughs into which the scoop spoons on the bottom of the connecting rods dip with sufficient force to throw the oil up in a fine spray. In each compartment there is a sloping gutter or channel which leads directly into the next forward compartment. The oil overflows the walls, which bound the troughs, and flows towards the rear of the engine and then by means of the gutters flows forward again, thus keeping up a constant flow. When it is desired to pump an extra supply of oil into the crankcase, as in the event of hilly country or long continued fast driving, a hand plunger pump is used. The pump is located in easy reach of the driver's seat.

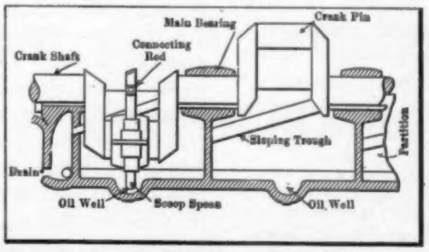


Fig. 10—Sectional view of the Cadillac base chamber, showing the scoop spoons, divisions and return flow sloping troughs

The crankshaft ball bearings are lubricated by means of centrifugal oil rings, which feed the oil into a copper pipe leading into a hole drilled into the crankpin and through the crank arm.

The camshaft has ball bearings which are also lubricated by the splash from the connecting rods. All the other bearings throughout the car are equipped with oil or grease cups and the transmission and differentials are packed in non-fluid oil.

SPLASH LUBRICATION ON CADILLAC.—The Cadillac four-cylinder car is lubricated by the splash system; the oil being carried at a constant level.

The bottom of the crankcase is divided into four compartments by metal walls which, besides dividing the crankcase into sections, form the saddles for the main bearings of the motor. In the center of the base of each of these compartments there is a short groove or dip forming an oil pocket of sufficient depth to allow the connecting rod to dip into it for a distance of about an eighth of an inch.

On one side of each of the compartments in the crankcase there is a sloping trough which leads directly into the next division in the crankcase. The sloping troughs in case of a superabundance of oil in any of the divisions, will catch up the oil and allow it to flow back to the next division; thus maintaining a constant level in the oil wells.

The splashing device consists of a hollow, bent scoop on the bottom of the connecting rod by which the oil is thrown up in a heavy spray. This flying mass of oil lubricates the cylinder and the wristpin bearing as well as all the other inside working parts of the motor, including the main bearings.

There is an oil reservoir with a capacity of about six pints located on the left-hand side of the motor. This oil tank is a rectangular box and is entirely separate from the crankcase casting. The same shaft which drives the magneto and water pump passes longitudinally through this tank; a double-acting plunger pump is driven directly off this shaft; its purpose being to take the oil from the tank and replenish the supply in the crankcase.

The pump forces the oil first up to a sight feed on the dash and through a tube to the crankcase. The number of strokes per minute made by the plunger pump bears a definite ratio to the revolutions made per minute by the engine.

After about between 500 and 800 miles the oil tank requires refilling through a strainer by opening a cap on the top of the forward end.

The universal joints run submerged in oil while the transmission and differential housings are packed in oil and grease. All other revolving and oscillating or sliding bearings are equipped with grease cups.

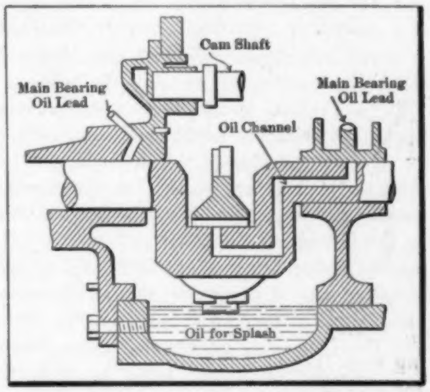


Fig. 11—Showing the troughs for splash and the method of oil supply to main and crankshaft bearings in Franklin motor

COMBINATION OILING SCHEME ON FRANKLIN CARS.—The Franklin car is lubricated by a combination of both the force-feed and the splash systems. The oil for the splash system is carried in the bottom of the crankcase in the oil pan casting, which is shaped so as to form beneath each cylinder a bowl of such shape that it clears at all points the curve traced by the extreme projections on the bottom of the connecting rod.

These basins hold a quantity of oil sufficient to allow the connecting rods to splash the oil up into the cylinders. The oil is thrown far enough up into the cylinder to lubricate the wrist pin. The camshaft also obtains its oil from the spray thrown up by the beating action of the connecting rods into the pools of oil in the bottom of the basins.

Besides the oil carried in the oil pan casing there is a supply in the force-feed reservoir. This reservoir which is boxlike in form is situated on the exhaust side of the motor so that in cold weather the exhaust will raise the temperature of the oil, thereby increasing its fluidity.

Inside the box tank there is a series of seven pumps which take the oil from the reservoir and force it through the sight feeds which are located on the top of the tank.

The pumps are driven directly from the camshaft by gearing and are all of the plunger type. They force the oil first through the sight feeds and then through to each of the main bearings. The crankshaft has an oil passage through it, as have also the cranks.

On the dashboard of the car there is a hand pump by means of which the oil may be drawn from the reservoir and put into the foremost crankcase.

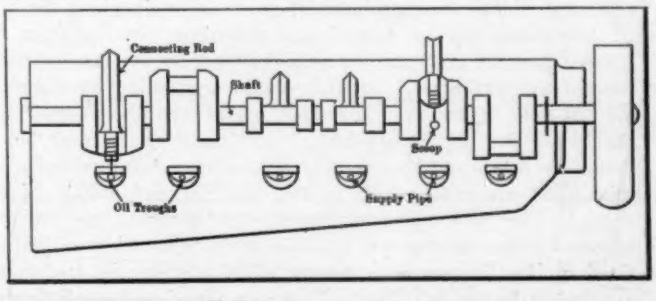


Fig. 12—Sectional side view of the Premier six-cylinder crankcase, showing oil scoops and the troughs under them

Short Stories of Current Interest

Unraveling the Puzzling Situation

Discussing some of the ideas that are uppermost in the minds of readers as they come to the Editor in the mail, presenting the point of view that generally obtains, without attempting to contend that the other angles of the same subjects are without force.

NOTHING would seem to be plainer than the fact that the lubricating problem is unusually complex, and those who have followed the discussion as it has been presented bv Charles E. Duryea, relative to the placing of the lubricating oil in the gasoline, will be struck by the enlightenment which came at the bottom of his last letter as it was presented in THE AUTOMOILE in the issue of June 8. After giving all of the reasons why he would resort to the advantages that come by the introduction of "naked simplicity" Mr. Duryea ended up by agreeing that the plan as advocated by him is substantially limited for exploitation in the types of motors that have a crankcase compression, as the various two-cycle motors. There are dangers attending the presentation of matter in this way, due to the fact that a reader might follow the arguments for two or three weeks, and become infatuated with the splendid presentation without ever knowing that the plan is limited, according to the statements of the authority quoted, to a very small percentage of the actual motors used at the present time, nor does this authority claim that this plan of lubrication would be effectual outside of the limited zone as fixed by him.

If there is anything in the contention that "practice makes perfect" there is ample evidence to sustain Mr. Duryea in the position that he takes, which has for its foundation the fact that the lubricating oil may be used in conjunction with the gasoline in the types of motors that have a crankcase compression, but there is one point involved in this method of procedure that should not be overlooked. In other words, lubricating oil resides in the crankcase, and it is used in the splash system of lubrication; moreover, there must be enough of it present so that the connecting rod caps or the scoops that are placed therein will dip in the lubricating oil and produce the splash required. Is it not worth while remembering that Mr. Duryea could not prevent the mixture of lubricating oil and gasoline under such conditions, it being the case that the gasoline with its attending air goes into the crankcase to make the initial compression required in a two-cycle motor? If Mr. Duryea will admit that this process of lubrication must be looked upon in the light of an inadvertence, who will claim that it may also be used as proof positive that mixing the lubricating oil and gasoline is the best and most simple plan to take advantage of?

Authoritative statements emanating from high sources relative to the lubricating problem all go to show that it is the duty of lubricating oil to furnish an unbroken film between the journal and the box. It is a self-evident fact that an unbroken film of lubricating oil can only obtain if nothing but lubricating oil gets in the cramped position between the journal and the box. The word "simplicity," quoting Webster, may be set down as follows: "The quality or state of being simple, unmixed, or uncompounded; as the simplicity of metals of the earth." The very word that seems so attractive to the contender of the mixing of gasoline with lubricating oil is defined in the dictionary so clearly as to preclude its use in the art under discussion. Most of us can afford to be a little suspicious of the word "simplicity" as it is too frequently applied, and of the hundreds of illustrations available, we think of nothing at the moment that will be more forceful for our purpose than to refer to the fact that "simplicity" is the appellation that is frequently applied to the apparel that is so hard to find adorning the ballet of the passing show. This, in our judgment, is a fair illustration of a type of simplicity that would be of small value during a polar expedition, and yet to designate Mr. Duryea's version of a simple lubricating problem in any other terms of simplicity would be out of the question were it not for the fact that he finally limited himself to specific applications that speak for themselves.

No automobilist can afford to advocate complexity, which, according to the dictionary may be defined as: "That which is complex; intricacy; complication." Here we have the implication that an aggregation of parts, for illustration, comprises more members with greater intricacy of relation than skill would sanction. Let us go in for designs that skill will sanction, but this should not deprive us of the pleasure of realizing real simplicity, which must be defined as present in an automobile that is possessed of as many parts as may be required to unify the functions and maintain stability of the relations. Just to show that a plurality of parts in the mechanism of a machine are not to be looked upon as complex, reference is made to the chronometer of the mariner, by means of which he reckons time and place, and of this marvelous piece of mechanism that permits him to travel from shore to shore across the great dividing waters of an ocean, there is nothing that can be said against it, despite the intricacies of its makeup, in view of the ract that the unknown waters are navigated through its direction, so that 5,000 miles are traversed, permitting the ship to nose its way into a harbor in the dead of night, or in the fog, and of the wrecks that occur, few, if any of them, are to be charged to the lying hands that point to wrong numbers on the chronometer's dial.

The best automobile that can be devised might well be termed a "chronometer" car; it would then have as many parts in its makeup as would point to success within the limits of human endeavor. But if we start out with an exaggerated ego, extending to the word "simplicity" a significance that the lexicographer refrains from laying claim to, we might carry the matter to the ridiculous length of dispensing with the axles, substituting wings, and doing the other things that a poet or a novelist would be able to see in his day-dream, but in all fairness, the task would not be concluded without changing the name of the object that would result from such distortions of the original plan.

It will be impossible to substantiate the contention that an object is an automobile unless it contains all of the mechanisms and parts that are essential to success automobile-wise, and "simplicity" will be amply present in a complete car, but the most diligent search would fail to find it there if even a bolt or a nut is missing, as many an automobilist is in a position to testify to by virtue of actual experience.

FAILURE to get good results from pneumatic tires occurs often enough to give the impression broadcast that there is something the matter with the tire situation, and those who know least about it hit on the "happy thought" that the making of tires is attended by a series of "impossibles," and that the day ought to come when rubber and cotton will be

"thrown to the dogs," substituting something more substantial by way of tires. The great minds of the world long ago admitted that a little knowledge is a dangerous thing. Referring to tires, it is this little knowledge that contends for the elimination of rubber and of cotton, and yet the men who are back of these complaints have it within their means to get what they want for the asking. All that will have to be done is to use solid tires instead of the pneumatic types, and keep the speed at which automobiles travel on the road within the limits as prescribed by the law, instead of committing a misdemeanor in the mere process of speeding. Any automobile will roll along the ground and perform satisfactorily if solid tires are used, and the speed is kept within twenty miles per hour, but when the rate of going reaches the point that even makes it difficult for railroad trains to stay upon ninety pounds of steel rails laid on splendid ballast, it is not to be supposed that solid tires will suffice for the end, or that the pneumatic types of tires will last without end.

But the difficulties involved are not entirely due to speeding, and some of them will have to be traced to lack of good understanding of the sizes of tires that should be used in given cases. Resorting to the philosophy of the thing it is only necessary to point out that all of the tire applications cannot be right because they are not all on the same basis. If tire responsibility responds to the formula $M V^2$ it remains for the makers of automobiles to obtain the "factor" of the respective models of their cars, and fix upon the sizes of tires to accord with the same. This will of course mean that various sizes of tires will have to be used, depending upon the weight and speed of the cars, rather than upon the weight only, which is a too common practice. A forceful presentation of the relation of weight and speed would have for its foundation the fact that an ordinary set of pneumatic tires would support a very heavy automobile for a very long time with the car standing still. As against this fact, it may be said that a very large set of tires on a lightweight automobile will wear out with surprising rapidity if the automobile is driven at a terrific high speed.

The users of automobiles have it within their powertired fve on their tire bills to a very large extent if they will do a little "nursing"; in other words, if they will drive carefully. In touring work, a good automobile is capable of averaging about eighteen miles per hour in a day's run, and a skilled driver would therefore understand that the best way to maneuver the car is to drive it at a speed of eighteen miles per hour. Reckless persons, those who are permitted to drive automobiles despite the fact that they are incompetent, have no better sense than to go by fits and starts, traveling one moment at sixty miles per hour only to put on the brakes and stop at a railroad track, or for some other obstructive condition, waiting a half-hour, more or less, for right of way. The steady pace may be counted upon to get the automobilist to his destination ahead of the fellow who has not learned that it takes an old dog for a long trot, and at the end of the month, when the "old dog" settles the score, he has money in the bank to spare.

Calendar of Coming Events

Handy List of Future Competitive Fixtures

Race Meets, Runs, Hill-Climbs, Etc.

June 20-23	Detroit, Mich., Summer Meeting National Gas and Gasoline Engine Trades Association.
June 24	Scranton, Pa., Hill Climb, Scranton Automobile Association.
June 24	St. Louis, Mo., Reliability Run, Auto Club of St. Louis.
June 30	St. Louis, Mo., Reliability Run, St. Louis Automobile Manufacturers' and Dealers' Assn.
June	Denver, Col., Reliability Run, Denver Motor Club.
June	Norristown, Pa., Hill Climb, Norristown Auto Club.
June	Oklahoma, Reliability Run, Oklahoma Auto Association.
July 1	Ossining, N. Y., Hill Climb, Upper Westchester Auto Club.
July 1	Baltimore, Md., Hill Climb, Automobile Club of Maryland.
July 3-4	Brighton Beach, N. Y., Track Races.
July 4	Kansas City, Mo., Track Races, Automobile Club of Kansas City.
July 4	St. Louis, Mo., Reliability Run, Missouri Automobile Association.
July 4	Bakersfield, Cal., Road Race, Kern County Merchants' Association.
July 4	Denver, Col., Track Races, Denver Motor Club.
July 4	Detroit, Annual Track Meet, Wolverine Automobile Club.
July 4	Pottsville, Pa., Track Races, Schuylkill County Centennial.
July 5-22	Winnipeg, Man., Fourth Canadian Competition for Agricultural Motors.
July 7	Taylor, Tex., Track Races, Taylor Auto Club.
July 8 or 15	Philadelphia, Track Races, Belmont Park, Norristown Auto Club.
July 14	Philadelphia, Commercial Reliability Run, Quaker City Motor Club.
July 14-17	Reliability Run, Minnesota State Automobile Association.
July 15	Worcester, Mass., Hill Climb, Worcester Automobile Club.
July 17-19	Cleveland, O., Three-Day Reliability Run of the Cleveland *News*.
July 17-22	Wisconsin Reliability Run, Wisconsin State Automobile Association.
July	Amarillo, Tex., Track Races, Panhandle Auto Trade Association.
Aug. 1	Chicago, Ill., Commercial Reliability Run, Chicago *Evening American*.
Aug. 3-5	Galveston, Tex., Beach Races, Galveston Automobile Club.
Aug. 12	Philadelphia, Reliability Run, Quaker City Motor Club.
Aug. 25-26	Elgin, Ill., Road Race, Chicago Motor Club.
Aug.	Denver, Col., Hill Climb, Denver Motor Club.
Sept. 1	Chicago, Ill., Commercial Reliability Run, Chicago Motor Club.
Sept. 1	Oklahoma, Reliability Run, *Daily Oklahoman*.
Sept. 2-4	Brighton Beach, N. Y., Track Races.
Sept. 2-4	Indianapolis Speedway, Track Races.
Sept. 4	Denver, Col., Track Races, Denver Motor Club.
Sept. 7-8	Philadelphia, Track Races, Philadelphia Auto Trade Association.
Sept. 7-9	Hamline, Minn., Track Races, Minnesota State Automobile Association.
Sept. 12-13	Grand Rapids, Mich., Track Races, Michigan State Auto Association.
Sept. 15	Knoxville, Tenn., Track Races, Appalachian Exposition.
Sept. 16	Syracuse, N. Y., Track Races, Automobile Club and Dealers.
Sept. 23	Lowell, Mass., Road Race, Lowell Automobile Club.
Sept.	Denver, Col., Track Races, Denver Motor Club.
Oct. 3-7	Danbury, Conn., Track Races, Danbury Agricultural Society.
Oct. 7	Philadelphia, Fairmount Park Road Race, Quaker City Motor Club.
Oct. 9-13	Chicago, Ill., Thousand-Mile Reliability Run, Chicago Motor Club.
Oct. 16-18	Harrisburg, Pa., Reliability Run, Motor Club of Harrisburg.
Oct.	Atlanta, Ga., Track Races, Atlanta Automobile Association.
Nov. 1	Waco, Tex., Track Races, Waco Auto Club.
Nov. 2-4	Philadelphia, Reliability Run, Quaker City Motor Club.
Nov. 7-10	Los Angeles-Phoenix Road Race, Maricopa Auto Club
Nov. 9-11	San Antonio, Tex., Track Races, San Antonio Auto Club.
Nov. 10	Phoenix, Ariz., Track Races, Maricopa Automobile Club.
Nov. 30	Los Angeles, Cal., Track Races, Motordrome.
Nov.	Savannah, Ga., Road Race, Savannah Automobile Club.
Dec. 25-26	Los Angeles, Cal., Track Races, Motordrome.

Foreign Fixtures

June 24	Boulogne, France, Coupe des Voiturettes.
June 25	French Light Car Race, Coupe des Voitures Legères, Boulogne-sur-Mer course.
June 25-July 2	International Reliability Tour, Danish Automobile Club.
July 4 (to 19)	Start of the Prince Henry Tour from Hamburg, Germany.
July 9	Sarthe Circuit, France, Grand Prix of Automobile Club.
July 13-20	Ostend, Belgium, Speed Trials.
July 21-24	Boulogne-sur-Mer, Race Meet.
Aug. 6	Mont Ventoux, France, Hill Climb.
Sept. 2-11	Roubaix, France, Agricultural Motor Vehicle Show.
Sept. 9	Bologna, Italy, Grand Prix of Italy.
Sept. 10-20	Hungarian Small-Car Trials.
Sept. 16	Russian Touring Car Competition, St. Petersburg to Sebastopol.
Sept. 17	Semmering, Austria, Hill-Climb.
Sept. 17	Start of the Annual Trials Under Auspices of *l'Auto*, France.
Oct. 1	Gaillon, France, Hill-Climb.

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REFERRING to the automobile engineer as a type mingled with his confrères, it is not impossible to compare him with the car of his conception on a basis of "striking energy," and to say that he makes up in enthusiasm for any latent inertia that may be lurking in his anatomy, but there is ground for the impression that he might possibly be found in the position of the Oriental chap whom the king promised all of the gold that he could carry from the vaults where it was stored to a river bank a mile away. It is a great mistake to start off with too much gold under such promising conditions. The responsibilities that are resting upon the broad shoulders of engineers to-day are too exacting, and there are too many of them to risk faltering in consequence of an overload, and it is more than likely that good judgment will have to supplant some of the enthusiasm. What the automobile business needs is the sand-papering down of its high spots and the filling in of the hollows between the hills. This will take some work, but the hands of the operators must be guided by the men who have judgment and discrimination as well as enthusiasm.

* * *

LOYALTY is a rare virtue in these days when every citizen wants to be a millionaire, and when every millionaire expresses a preference for exclusiveness in his particular line, and many of the things that are being undertaken automobilewise are lacking in certain respects, due to the fact that old-fashioned loyalty is at a premium, and the men who should be thinking how they could serve in their employ better are conniving with those who will bend the head and offer the listening ear for no better purpose than to feather their own nests at the expense of their self-respect. There never was a time when the world needed loyal men more than it does to-day, nor can it be claimed in any other business, of which we have an authentic record, that there is such need of loyal attention on the part of the men who gather their livelihood out of it as the automobile business. There is no lack of foresight in the type of man who has the cleverness to make the most out of even a bad situation, and it is this type of man who stands for success when he is permitted to operate under favorable auspices. It is this type of man, too, who has the ability to make a favorable impression, so that opportunity as it goes in quest of a lodging place is likely to stop at his door and pronounce itself "at home."

* * *

PULL is the malignant fester that gets in the way of success. It has many ramifications, and it deceives its victims because it possesses the faculty of looking pleasant. The man with a "pull" is a pest. His natural ability is under the shadow of a sense of security that grows out of his "pull," and besides being a victim of his own self-satisfied state he drags down the source of his inspiration until the level on which he stands, while it should be the playground of success, becomes the stalking place for the skeletons of failures. This condition called "pull" does not confine its operations to mere men; it attacks organizations as well. When a company gets the impression that it is operating under the favorable auspices that suggests a "pull" its activities are slowed down under the impetus of the management that is resting upon its laurels, unmindful of the fact that the "overhead," like the mills of the gods, grind slowly but surely. Even purchasers of automobiles, thinking that they have a pull with some particular maker's representative, overlook the fact that the automobile there to be had is far from what they want, bow to the influence of the "pull" at the expense of judgment and fall to the ground.

* * *

PUTTING off the evil day is the resort of 450,000 users of automobiles in this country, this being the number of automobilists who do not try to understand the mechanisms of their cars and who do not know the difference between use and abuse. The idea that an automobile will go on forever, bowing to the will of its taskmaster in the face of continued abuse, has as much foundation as might be represented in the condition that would obtain were the same taskmasters to substitute horses and to get service out of them without returning service. Just as goods for goods is the foundation of commerce, service for service is the basis of efficient operation when reference is had to a horse or an automobile. The owner of a horse must serve the animal by feeding and grooming him, and the animal in turn serves the owner by bearing him from place to place. Obviously, the owner of an automobile must serve it in a way that 450,000 owners of automobiles have yet to learn, and until they do acquire a smattering of this necessary knowledge they will have to pay for their backwardness,

Two Days' Racing at Brighton Beach

July 3-4 to See Racing at Historic Course

Automobile racing in the metropolis will be seen on a major scale for the first time in 1911 at the opening meeting at Brighton Beach, scheduled for July 3-4. The official entry blanks outline nine events for each day, but do not include a single stock car contest. There are all kinds of special races for special racers and a feature of the announcement is that the Remy brassard will be awarded to the winner of a sprinting race which will be run in heats.

ENTRY blanks for the forthcoming two-day race meeting at Brighton Beach July 3-4 have been issued. According to the announcement there will be nine events run off each day and not a stock car race in the card.

Monday's program includes two numbers for Class C cars at 5 miles for divisions 2 and 3C. There are also two Class E events for divisions 4 and 5E at the same distance. A free-for-all at 5 miles under handicap will follow. The last half of the card is made up of a novelty race for fully equipped cars, the novelty consisting of loading and unloading passengers; a free-for-all, which may be the first heat of the contest for the Remy brassard, either three or five miles with flying start; an hour race for Class E cars under 600 cubic inches and with minimum weight of 2,100 pounds for the W. B. trophy and a series of 1 mile exhibitions.

Tuesday's card includes exhibition trials, one Class C race, four Class E races, three Class D events, embracing the final heat for the Remy prize, if it is given, a handicap, and an Australian pursuit race.

According to officials of the Contest Board there has been considerable comment upon the conditions framed for the brassard event. The records show that the prize heretofore has been fought for over a distance of ground and not in sprinting events. At the same time it is pointed out that the promoter of the meet, E. A. Moross, is the titular owner and manager of a string of cars, one of which looks like a copper-riveted surething if it is entered.

The officials state that the $75 a week that is one of the emoluments attached to the brassard, would go quite a long way toward paying railroad fares for the "string" if the car referred to was fortunate enough to win.

Another statement contained in the entry blank also came in for some comment on the part of the officials. This was with reference to one of the provisions of the deed of gift conveying the W. B. trophy. It is stated that in addition to the July 3 contest for this prize that there will be three others held at Brighton Beach at which the trophy will be offered. These dates are set out as July 21-22, September 2-4 and the latter part of September, approximately.

At the Contest Board it was learned that the July 22 date had already been pre-empted for another race meeting at a different New York track and that September was so far away that nobody knew whether there would be anybody alive at so remote a period.

Figure on Glidden Compromise

DETROIT, June 21—Representatives of the Premier Motor Manufacturing Company and the Chalmers Motor Car Company are in conference here with reference to a basis of settlement for the Glidden Trophy litigation. A session was held yesterday without definite result and the lawyers on both sides retired for additional conference with their principals. Another session will be held to-night or to-morrow. Chairman Howard E. Coffin of the M. C. A., called the meeting. S. M. Butler, chairman of the Contest Board, was present.

Atlanta Trade Fully Organized

ATLANTA, GA., June 19—For the first time since the days of Atlanta's one and only automobile show the automobile and accessory dealers are organized. In two sessions, one to-day and one last Saturday, the Atlanta Automobile and Accessory Dealers' Association was launched.

The officers elected were Geo. W. Hanson, president; F. J. Long, vice-president; C. L. Elyea, second vice-president; W. E. Gordon, secretary and treasurer. The directors named were F. J. Long, Lindsay Hopkins, M. C. Huie, H. A. Price, W. D. Alexander, J. W. Goldsmith, Jr., W. G. Hollis and F. C. Steinhauer.

Everitt Announces a "Six"

DETROIT, June 21—The Metzger Motor Car Company has announced that its 1912 line will include a six-cylinder model, besides two four-cylinder cars. The automobiles rate at 48, 36 and 30 horse-power respectively, and will sell for $1,850, $1,500 and $1,250. Automatic pneumatic starters and full equipment are included in the selling prices of the two larger cars.

Shanks Now with W., C. & P., Inc.

Charles B. Shanks, veteran newspaper man and pioneer in the automobile business, has returned to the fold, attaching himself to the Wyckoff, Church & Partridge, Inc., enterprise in the exploitation of the Commer truck and the manufacture of the Guy Vaughan car.

Mix-Up at Milwaukee Races

MILWAUKEE, June 20—The two-day race meeting postponed since last Friday by reason of rain commenced to-day. An unfortunate mix-up in one of the class races marred the day's sport. A Ford car entered and won the race but was disqualified because it was under weight. Considerable comment was made that the car should be allowed to start under the conditions and after starting and winning that it should be disqualified for being under the weight limit.

Charles B. Shanks, an automobile pioneer, now with Wyckoff, Church & Partridge, Inc.

Guttenberg Meet Attracts Thousands

Big Crowd Sees Interesting Card Decided

With a big crowd present to enjoy it, a good program of races was presented at the frayed and dilapidated Guttenberg track on Saturday afternoon. There were perhaps 1000 ladies present despite the inadequate accommodations for them. The line of stalls used for Sunday motorcycle races obstructs the view of the course and the officials were obliged to use stands that will be destroyed the first time a racing car skids into them, which may happen in any race. Two Nationals, two Simplex cars, an E-M-F, Schacht and Regal were the winners.

FAR and away the best automobile race meeting ever held on the ancient and dilapidated Guttenberg race track was given Saturday afternoon before an audience estimated at over 3,000. There was not a hitch in any part of the program and not the semblance of an accident. As for the sport, it was enjoyable despite the fact that there were no tight fits at the finishes.

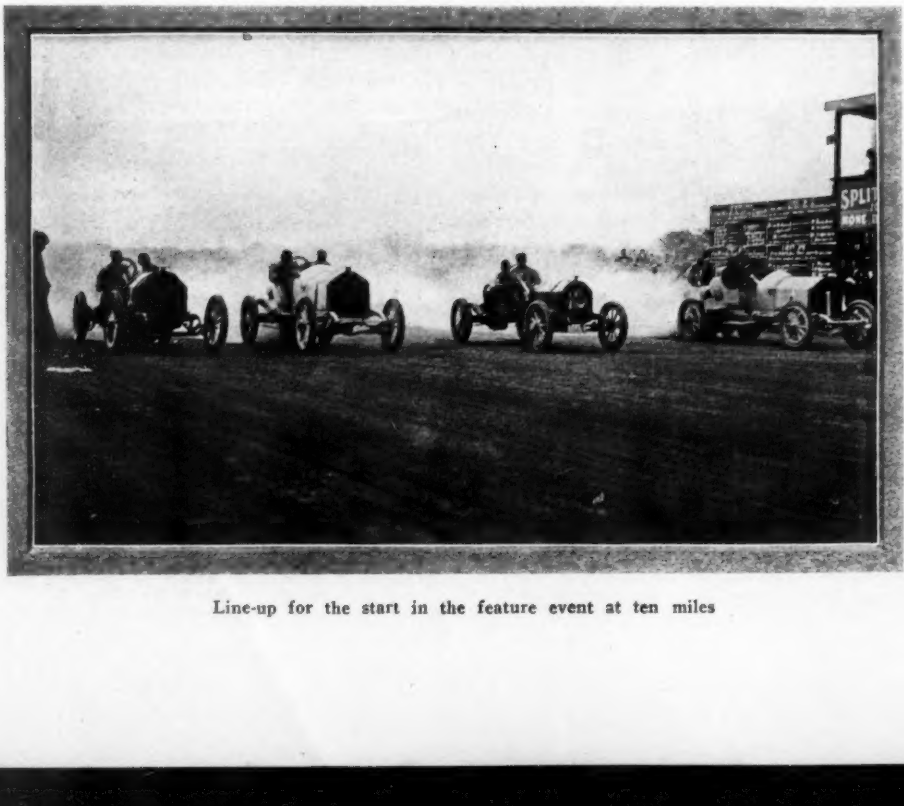
Six events were carded and seven were run, because of the failure of all but one entry in the fully equipped race to qualify.

The extra race was a match between two Simplex cars owned and driven by amateurs. No stock car races were on the program.

The spectacular feature of the afternoon was the close competition afforded by two National cars in all three of the events in which they started.

The first race drew a field of six and the E-M-F entry, in pole position, jumped to the front at the gun and tin-canned along in front all the way through the five circuits, winning handily in 6:09 from the Lancia and Paige-Detroit.

In the second, a Schacht roadster made a remarkable showing, and carrying Mr. Gray, who was twice as large as any other man in the race, it won from end to end, going away at the finish. The E-M-F that won the first race was second and the Lancia third. The time of the winner was 5:59 2-5, and the winner could have gone considerably faster.



Line-up for the start in the feature event at ten miles

Then came the prettiest struggle of the afternoon, when two Nationals and the old Wheatley Hills Marmon met at ten miles. The Nationals ran like a tandem team for eight miles, with the Marmon trailing, when the right rear tire of the lead-

National, No. 1, winner of one race and contender in two more

ing car blew out rounding the "club-house" turn, leaving the other National to win rather easily in 10:42 2-5 from the old racer.

In the next event, also at ten miles, National No. 1 kept its feet and won in a sharp drive from its team-mate, with Simplex No. 38, fresh from the gruelling race at Indianapolis on Decoration Day, a distant third.

Regal 15 had a walkover in the next regular number, and then followed the match race between the Simplex pair. Mr. Heitmeyer's 90-horsepower car, driven with much skill by its owner, had too much speed for its smaller brother, driven by Mr. Munro, who is considerably heavier than Mr. Gray, who drove the Schacht to victory earlier in the day. The weight on the right rear wheel made the turns extremely perilous for Mr. Munro, but he came through without mishap.

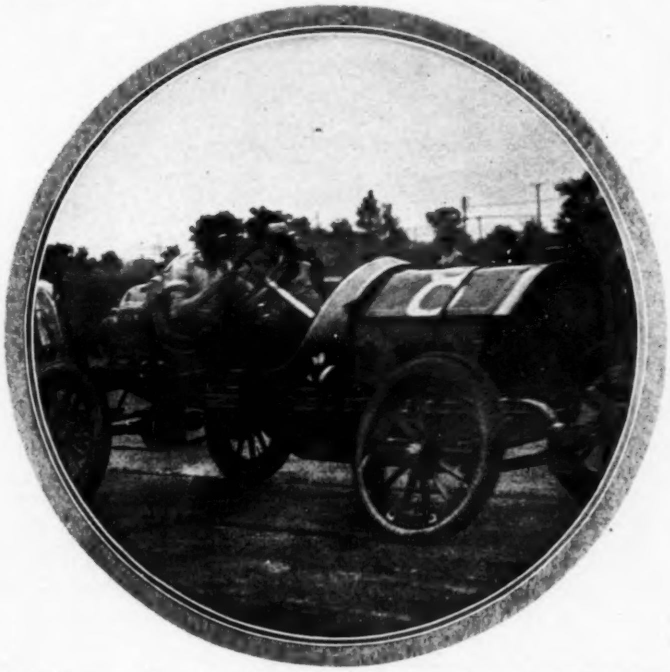
The free-for-all, last on the card, brought out a field of five and resulted in another victory for Mr. Heitmeyer's Simplex, which was driven by a professional driver in this event. The winner took up the pace in the first dash and held the leading position to the end. The

National pair had a fierce battle for the place, No. 11 outspeeding its mate in the last three miles.

A. F. Camacho, who recently returned from South America, acted as referee and starter, and T. B. Shoemaker represented the Contest Board. The New York Timers' Club took the times.

Fully 300 private automobiles were packed in the infield, paddocks and around the rail. The transportation facilities for those who did not make use of automobiles were execrable, as usual.

The track had been considerably improved under Mr. Shoemaker's orders, and, while the racing cars raised much dust, its condition was vastly better than it has been in the past. The "club-house" turn is still in horrible shape and the back stretch is rough and rutty. The summary:



Schacht entry, No. 8, that won its race easily, making a speedy showing

Ten Miles, Class E, Under 601 Cubic Inches

No.	Car.	Driver.	Position.	Time.
1	National	Whelan	1	10:30 2/5
11	National	Koopman	2	
38	Simplex	Beardsley	3	
10	Marmon	Burnich	4	

Five Miles, Class E, Under 231 Cubic Inches

2	E-M-F	Burke	1	6:09
3	Lancia	Ferguson	2	
5	Paige-Detroit	Craig	3	
4	Regal	Ainslee		
15	Regal	Tate		
6	Overland	Gasteiger		

Five Miles, Class E, Under 301 Cubic Inches

8	Schacht	Gray	1	5:59 2/5
2	E-M-F	Burke	2	
3	Lancia	Ferguson	3	
9	Correja	Gillam	4	
4	Regal	Tate		
7	S. P. O.	Robinson		

Ten Miles, Class E, Under 451 Cubic Inches

11	National	Koopman	1	10:42 2/5
10	Marmon	Burnich	2	
1	National	Whelan		

Five Miles, Non-Stock, Fully Equipped

15	Regal	Tate	Walkover	6:44 1/5

Five Miles, Match Race, Amateurs

14	Simplex	Heitmeyer	1	5:20 2/5
12	Simplex	Munro	2	

Ten Miles, Free-for-All

14	Simplex	Ormsby	1	No Time
11	National	Koopman	2	
1	National	Whelan	3	
38	Simplex	Beardsley	4	
4	Regal	Tate	5	

Booming Detroit-Toledo Highway

TOLEDO, June 19—The Toledo-Detroit highway project took more definite form this week, when a meeting was held at Monroe, Mich., and a good roads association formed by the Monroe county boomers. This association will become part of a tri-county committee of which Lucas county members will be selected by the Toledo Commerce Club, and those representing Wayne county by the Detroit Board of Trade. There were 54 in the Toledo delegation at the meeting, and Wayne county, which has already built its part of the road, had six representatives.

About 250 were in attendance altogether. Commissioner Romeis said Lucas county was prepared to build its 5 miles of the road to the Michigan line as soon as the specifications and material were made known.

Monroe county has 38 miles of the new road to construct. When Col. J. C. Bonner, of Toledo, announced that Toledo was willing to contribute liberally to the building of the Monroe county road Horatio Earl said Detroit would give $2 to every one that Toledo would give for this purpose. "The road can be built for $3,500 a mile," said Horatio Earl. "If Toledo will give one-third, Detroit will give two-thirds."

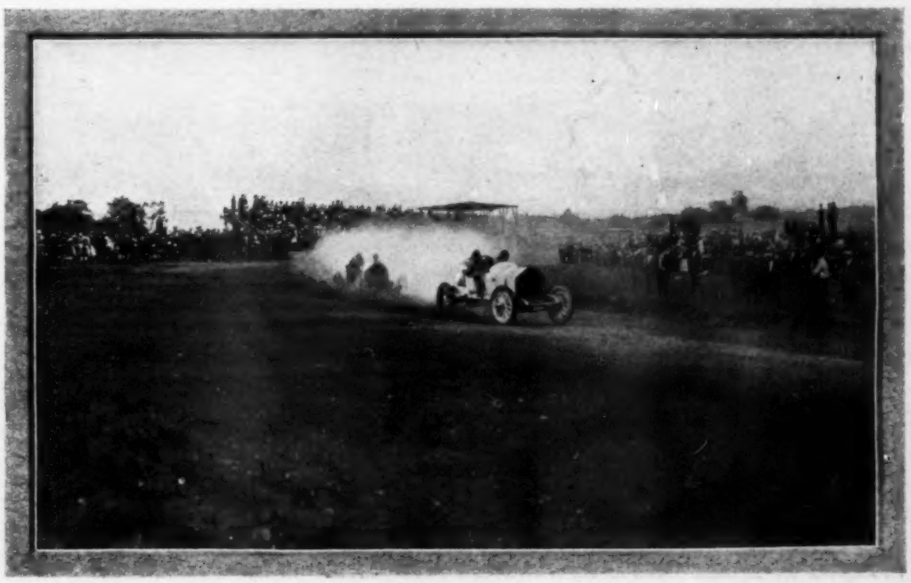
Portland Floral Parade a Beauty

PORTLAND, ORE., June 19—With more than $1,000,000 worth of cars, buried beneath millions of rose blossoms and other flowers, with nearly 2,000 beautiful and handsomely gowned women taking part, the annual festival parade of decorated automobiles held sway in Portland recently, and passed into history as one of the greatest achievements ever undertaken anywhere or by any city since the industry was born.

There were nearly 500 cars of all makes, sizes and designs from the tiniest electrical runabout to the large and stately limousine and the ponderous motor trucks.

Maryland Hill Climb Arranged

BALTIMORE, MD., June 19—There will be eight classes in the hill climb on the Belvidere Hill, Mount Washington, under the auspices of the Automobile Club of Maryland on July 1. The most interesting will be that for owners of cars to be driven by themselves as amateurs. There will also be classes for cars ranging in price up to $3,000 and over $3,000, as well as the free-for-all.



Sharp brush on the "Club-house" turn in big car event

Hanch Decries Season Models

"The season model idea in the motor car trade is neither logical nor sensible," says Charles C. Hanch, treasurer of the Nordyke & Marmon Co. "I base this assertion upon the fact that in all trade and commerce articles which have been continuously designated by season models or yearly styles have been such articles as ordinarily last but one season. There was a time when the average motor car was not considered good for more than about 5,000 miles, and radical changes followed each other in rapid succession.

"At that time the ordinary purchaser expected to get a new car almost every season. The season model idea grew out of these conditions, but it is now out of date. There is but one logical result of continuing the season's model idea, and that will be an undignified scramble among manufacturers to see who can first announce his next season's model. This, carried to an ultimate conclusion, will find certain makers, on January 2d of a given year, announcing their models for the succeeding year. Manifestly a ridiculous performance, and I know of no more certain death for any commercial or personal practice than to subject the same to ridicule. There are innumerable reasons why the season model idea is wrong; among others, a few may be mentioned.

"It is not fair to the purchaser to sell him an article, represented to last a number of years, and within a week or so thereafter announce changes in the same article, calculated to make the first purchaser feel that he has an out-of-date product. Did anyone ever hear tell of the owner of a horse vehicle boasting to his friends that he had a '1912' victoria or brougham? Or a '1913' span of gray horses? Certainly not. The modern motor car of a reputably developed type is, under ordinary circumstances, as permanent an article as the average horse vehicle.

"The public should be given the benefit of any material improvements in motor cars at the end of any manufacturing lot, regardless of whether the lot ended in the middle of the season, or at the close of the season. It would be fairer to the public, and of more concern to it, if the manufacturer would announce that the cars sold during any season were designed and developed one or two years previously, as every maker should experiment at his own expense, rather than at the expense of his customers.

"The season model idea involves eagerness to make changes, as, without changes, the announcement of a new model is more or less ridiculous. It is the duty of every manufacturer to improve his product and keep up to date, but there should be no unnatural incentive for hastily putting changes on the market before they are thoroughly tried out. On the other hand, when improvements are perfected they should be given to the public without regard to season.

"Summing up, it is not any more sensible to have season models in the motor car trade than it would be in the carriage, cab, wagon or traction engine trade."

Abbott-Detroit Opens Service Department

In order to care for the needs of the Abbott-Detroit cars in New York, the Abbott-Detroit Motor Company, has opened a service department at 112 West Fifty-second street. The department will specialize in its stock room so that vexatious delays will be avoided in making emergency repairs.

One moving cause of the installation of the new department is the fact that considerable trouble has been experienced with the general run of repair shops that have lacked the special facilities to handle such cars. In order to prepare against such contingencies the company has selected a man for the head of the department from the pick of the factory staff.

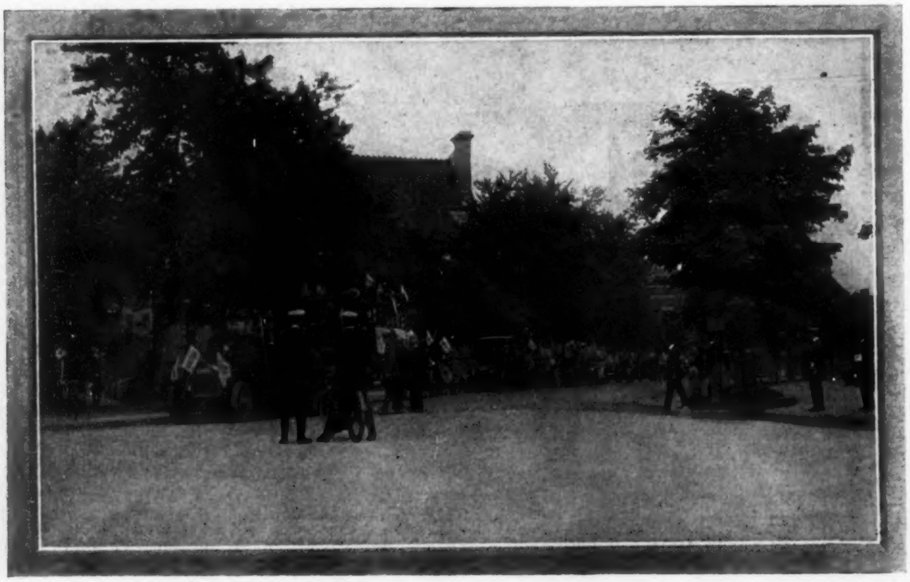
United States Tire Company Building Home

Ground has been broken, and building operations are under way, for the new twenty-story office building which, when completed, will be occupied by the United States Tire Company. It is located at Broadway and 58th street, New York City. Most of the floor space will be used by the United States Tire Company and the United States Rubber Company. It is expected that the new building will be ready for occupancy by January 1, and when finished will be an imposing addition to New York City's automobile row.

Kinsey Company Enlarging Plant

Toledo, O., June 19.—Plans are now being prepared and the contract will be let within the next two weeks for two large, fireproof and strictly modern buildings which will be erected by the Kinsey Manufacturing Co., makers of automobile parts. Isaac Kinsey, president of the company says: "The demand for automobile parts not only from the Ohio trade, which we supply, but from many automobile manufacturers in other cities, makes it imperative for us to enlarge our plant and increase our number of skilled employees."

Work on the buildings will be rushed and it is expected that they will be ready for occupancy before the close of the summer. They will give the company nearly an acre of additional floor space and enable it to employ at least 100 more men, which will bring the maximum force of skilled mechanics to about 800.



Start of the Orphans' Day Outing which was given to the little ones in Brooklyn recently

Brooklyn Orphans' Day a Success

Under beautiful weather conditions Brooklyn's Annual Orphans' Automobile Day was celebrated last week on a scale never before equalled. There were more than 300 pleasure cars in line to accommodate the guests of the day and about fifty big trucks assisted in this service.

The total number of children who enjoyed the ride to Coney Island and the pleasures of the resort during the day was over 3,000. The affair was pronounced by far the most successful of its kind ever given in Brooklyn.

C. A. A. Wins Club Contest

Inter-club run decided last week between teams representing the Chicago Athletic Association and the Chicago Automobile Club resulted in a victory for the former. The run was to Janesville, Wis., and return, the last half being through heavy rain. This was the fourth running of the event, three of which have proven triumphs for the athletic club.

CHICAGO, June 19.—The annual inter-club reliability team match between the Chicago Automobile Club and the Chicago Athletic Association was contested Thursday and Friday of last week and resulted in a victory for the Chicago Athletic Association representatives by a score of 306.6 to 685.

This was the fourth running of the event and the third victory scored by the C. A. A. The run was to Janesville, Wis., and return, a total distance of 248 miles—128 miles the first day and 120 the second, covered at an average speed of 18 miles an hour. There were fifty-one entries, but scratches pulled the field down to thirty-five—twenty-two on the C. A. A. team and thirteen on the C. A. C.—all of whom finished but one. Owing to the difference in the sizes of the two teams the C. A. A. was penalized only 13-22 of a point, which brought its total of 519 down to 306.6.

The contest was an easy one of the grade 3 style, with penalties imposed only for work done on the road and for being late at control. Despite this the affair proved to be really strenuous because of the run from Janesville to McHenry yesterday morning. The clubmen started off in a downpour of rain. They discovered when out of town that the road was being repaired, and there were several stretches that were nothing but sloughs of mud, which wrecked many perfect scores. Cars were stuck in the mud for several hours, and the trip was a hard one. Most of the cars, though, went through with clean sheets and reached the noon control on schedule. Referee N. H. Van Sicklen, Sr., took cognizance of the roads in the afternoon and changed the route, sending the teams in by way of Algonquin and Elgin instead of through Volo and down the north shore.

The run the first day was comparatively uneventful, only three of the thirty-five cars being penalized. There might have been more, for the afternoon schedule was unwittingly figured at the rate of 21 miles an hour instead of 18, and some of the drivers had to beat it to get in on time.

No serious trouble developed. Knisely of the C. A. A. team drew 130 points because of damage done to his differential housing when he hit a big rock that was hidden by grass. His warning saved others from getting into trouble at this point. Griffin of the C. A. C. had magneto trouble that brought him a big bunch of penalities, while Hyman of the losing team was penalized 195 points because he refused to quit. N. H. Van Sicklen, Jr., of the C. A. C. withdrew on the return journey and took 150 points.

Following the finish of the contest last night there was a supper at the Chicago Automobile Club, for which the losing team paid. The first day a Mais truck, serving as a commissary wagon, hauled eatables from the C. A. A. to Marengo, the noon stop, where the contestants enjoyed a picnic lunch. Owing to rain on the second day this plan was abandoned, and the clubmen took pot-luck in a country hotel at McHenry.

There were ten clean scores on the side of the winning club and five cars that finished without demerit in the Chicago Automobile Club.

Following is a tabulation of the scores of the two teams for both days of the contest:

CHICAGO ATHLETIC ASSOCIATION.

No. Entrant.	Car.	First Day.	Second Day.	Total.
	Diamond T	0	77	77
1—C. T. Knisely	Cole	0	14.8	14.8
3—S. W. Hamm	Rambler	0	0	0
5—F. W. Wentworth	Oakland	9.4	25.4	34.8
7—W. G. Beek	Palmer-Singer	0	0	0
9—W. C. Thorne	Rambler	0	11.2	11.2
11—Walter Chamberlain	Chalmers	0	0	0
13—C. A. Briggs	Chalmers	0	0	0
15—W. E. Davis	Selden	0	4.2	4.2
17—J. H. Dunham	Diamond T	0	0	0
19—W. F. Grower	Packard	0	0	22.5
21—C. O. Owens	Cole	0	0	0
23—E. H. Young	Mora	0	21.5	21.7
25—W. W. Harlass	Locomobile	0	41.5	41.5
27—H. G. Jackson	Columbia	0	0	0
33—Harry Daniels	Packard	0	0	0
35—S. E. Hibben	Stoddard-Dayton	0	13.2	13.2
39—A. E. Coon	Stearns	0	0.69	0.69
43—W. W. Jaques	Stearns	0	0	0
45—C. E. Jaques	Locomobile	0	54.5	54.5
47—E. Bolter	National	0	10.6	10.6
49—A. Ortmeyer	Peerless	0	0	0
51—L. T. Jaques				
Total		9.4	297.2	306.6

CHICAGO AUTOMOBILE CLUB.

No. Entrant.	Car.	First Day.	Second Day.	Total.
2—A. S. Ray	Stearns	0	38	38
4—Henry Bosch	Stearns	0	9	9
6—T. J. Hyman	Chalmers	4	191	195
8—E. T. Franklin	Moon	0	0	0
10—N. H. Van Sicklen, Jr.	Apperson	0	150	150
14—G. F. Griffin.	Marion	0	220	220
16—Charles Turner	Knox	0	64	64
18—P. J. McKenna	Pierce-Arrow	0	0	0
20—John Magee	Stearns	1	6	7
22—W. H. Jones	Winton	0	2	2
24—W. Egermann	Rambler	0	0	0
28—H. H. Fryette	Halladay	0	0	0
30—Carroll Shaffer	Stevens-Duryea	0	0	0
Total		5	680	685

The S.A.E. Convention

(*Continued from page* 1379)

PRESIDENT: The members will doubtless notice that we have not gone as far with roller bearings of any type as we have with ball bearings.

MR. FERGUSON: I don't really know the reason why we haven't gone very far in roller bearings, except that there are very few makes of roller bearings in comparison with the ball bearings.

PRESIDENT: There is one other item: One of the parties interested has expressed the believe that tolerances should be expressed with no plus tolerance for the bore of the bearing and that the tolerance should be all on the minus side. There is another opinion to the effect that the tolerance should be equally distributed.

MR. FERGUSON: I think we ought to have a plus and minus tolerance. I would suggest .0003 plus or minus. It would be alright if they would work to nothing over and minus to .0003. But I think there ought to be something under and over.

MR. POOR: I would like to bring before that standards committee the question of recommending to users of ball bearings the tolerances that they should adopt in their mountings. If they should specify in the report of the committee here the tolerance which should exist in the ball bearings itself, why would it not be a good scheme to offer some suggestions for the tolerances in the mountings?

Noon control at Marengo, Ill., of the Inter-Club Run arranged by C.A.A. and C.A.C.

Mr. Sweet: In regard to Mr. Ferguson's remarks about limits. We find in manufacturing it makes little difference how far the maximum or minimum is put on the unit. If we are going to get a tolerance of three ten-thousandths, it makes little difference whether it is plus or minus.

President: Is there any manufacturing reason why tolerances should be all minus rather than plus or minus?

Mr. Sweet: I never heard of any.

Mr. Salter: On the matter of tolerances I can only suggest that it would seem desirable to have a plus or minus, in view of the fact that it would be more definite. For instance, if it was ten or twenty or thirty millimeters, it would be that number, plus or minus a given tolerance, whereas if it is not a definite dimension, it makes little difference.

Mr. Sweet: I would suggest that wherever you have two pieces to assemble in harmony, it seems to me that a given one should be the unit. If you have got the tolerance on each part, it takes one of those parts entirely away from the other. If you are going to have a variation plus or minus, then this engaging piece must be.

Mr. F. W. Cooke: It would be advisable to have limits that apply to mean conditions, in regard to connecting parts of making and cutting tools. By that I mean that most cutting tools are bought in standard size, and when they get them a certain size they certainly cannot plug them. That is, you cannot plug the holes. Most of the holes are a little over size.

President: In that case, the tolerance would be which way?

Mr. Cooke: For the external dimension of the ball bearing, my opinion is that the tolerance should run plus; that is, over size, plus.

President: And the opposite part of the bearings?

Mr. Cooke: That can be regulated, because the work is usually measured in the shop.

President: That corresponds with the opinion that I have mentioned, that there is a strong suggestion of a manufacturing reason why there should be plus tolerance in some cases and minus tolerance in others. It seems like we are discussing small matters in discussing .0003 or less, plus or minus. But some of the companies are working down to those ranges, and we must get the whole situation clarified.

Mr. Birdsall: I would like to indorse what Mr. Cooke says, and I think it will be found in laying out work that if the outside dimensions were zero to plus and the inside zero to minus, it will make very much easier the work of laying out the bearings and also in the shop. But in regard to tolerances, I think we ought to hold them closer than to .0006. Any firm that can make a good radial bearing, they are working closer than that on the inside race, and if they cannot work to .0003 on the outside diameter, and the inside diameter under that, their inside races are not good. I think from zero to .0003 over on the outside and zero to .0003 under on the inside is big enough limits.

Mr. Poor: In regard to zero and .0003 on the outside, your radial bearings have got to have a sucking fit, and you would have a tight fit. You have got to get a larger bore on the outside diameter. The limit on the outside would preferably be under the large dimension rather than over, because when you are making your mounting the inner side of your mounting and the outside of your bearing must be made within certain limits and you have got to have a sucking fit on the bearings. You may have a tight fit on the outside of your race if you make it plus on the outside,—which isn't the proper way.

Mr. Sweet: In speaking of standard tools, the large manufacturer is affected very much by standard tools, because he makes them in sufficient quantities. Supposing we are going to use a standard tool,—a standard reamer. A standard reamer cuts down in a very short time. Now, just as soon as it loses that keen edge,—from that on it is a very durable tool. And because the reamers are apt to wear slightly, it would seem to me for that reason that we ought to drop below the standard, and as that gentleman suggested, I think we should use the standard of the male diameter and use the standard minus; and use the standard of female diameter and use the standard plus.

President: What do you regard as proper tolerance for a ball bearing,—the bore for example.

Mr. Sweet: Of course we desire to get it as close as we can. We don't have any trouble in getting .0003.

Mr. Birdsall: On this paper, there is one point, and that is the radii of the corners. There is a figure given here which shows the corner of bore of the inner race. I suppose those are the radii of the corners. I think that the radii of all four corners,—all four edges should be given and have as few of them as possible, and also make them as large as possible to have them clear the felloes on shafts on which they are used.

Mr. Perrin: There are two other points: the amount of tolerance for press fits, and the amount of side play desirable. Of course, when the bearing is loose, it will permit a higher press fit than a tight bearing. I know in some parts of an engine to get the engine quiet you have got to have the bearings with the least amount of side play, that is, wobbling, and in doing so it reduces the amount of tolerances permitted in the press fits, and in demanding of the ball bearing manufacturers to give us bearings that have the least amount of side play, they have fallen back on that as an excuse when any bearing has failed, it is due to too tight a press fit. So that it amounts to working within very close limits. I believe the standard should be made with not more than a total tolerance of .00045; plus or minus two to two and a half ten thousandhs, with any standard to work to. For as long as you have any standard to work to, I don't believe it makes any difference whether it is plus or minus.

Mr. Hertner: There is at least one point and I think two points where the committee has not taken up the matter of tolerances, and one is eccentricity; that is, the amount of motion up and down of the outer race when held stationary and the inner race revolving; and the other point is what we call wobbling;—the sideward motion of the outer race when the inward race is revolving. We have made experiments with fifty bearings; they were fairly close in regard to inner and outer diameters, but were way out of true as far as eccentricity, and a great many were out of true as regards this matter of wobbling.

Mr. Hertner: What I suggested is this: If you keep the inner race revolving and then forcibly hold the outer race to one side, there will be an actual motion of the outer race, which is due to the fact that the race is not ground accurately in relation to the inner and outer bore.

Mr. Trask: Well, now, when you press a bearing into its seat, into the hole in which it fits, it must necessarily increase or tighten rather the fit on the balls, and, correspondingly, if the bearing is pressed into its shaft, it will enlarge the hole slightly and tighten it. I think that is what Mr. Perrin has in mind. In regard to the press fit, many of us use bearings that we do not press into its seat or into its shaft;—use a sucking fit in each case. And under those conditions, if the balls fit each half of their race as they should, it would seem that under other conditions, with anything like a tight press fit, the balls will certainly be too tight.

President: It may be interesting to know that an attempt was made to get a definition of a sucking fit and press fit and drive fit and the different other fits that we may have. Nothing was arrived at, but we did get several opinions and very likely at another meeting that may be indicated.

Mr. Perrin: Our experience has been very satisfactory that way. Only one point I had in mind. I was wondering if any of the companies that have been using that form of construction have noticed any deterioration in the quality of the balls furnished in the last year and a half. I have noticed a little difference in quality lately.

Mr. Spicer: The question has come up in regard to the matter of square broaches in particular. It seems to some of the committee that it is exceedingly doubtful whether the people who design squares, a good many of them at least, appreciate the value of the corners, and it is particularly the squares that I, as one of the members, am interested in. You will notice on page 5 of the report that you have that we decided to recommend two standards of sizes, that is, two proportions. Taking the ratio,—the short diameter to the long diameter,—that ratio of a perfect square is very close to .71. This of course goes without saying,—should be easily demonstrated,—that a given amount of bearing surface near the corner of a square is worth a great deal more than the same amount of surface near the middle of the square. For that reason, for sliding fits, in order to keep the bearing pressure down to base of lubrication, it is desirable to get it as close to the corners as is commercially practical to make the holes and shafts. We therefore recommend the ratio of .73, which in every case gives a reasonable channel ground on the corners and avoids any difficulty that might be had with keeping the broaches up to a sharper corner. As I said, that is a matter of lubrication. On the other hand, where we have what we call fixed fits;—that is, where there is no sliding action, and permanent fit, there is no necessity for carrying the square out to the full square for the reason that the only limiting feature is the crushing pressure that the materials will stand. It is therefore unnecessary to remove the extra metal which of course is an economical proposition; and the larger the square is across the corners, of course the larger the hub must be on the outside, in order to give necessary strength, and so that was why we adopted the other ratio; that is, of 8.

Mr. Garceau: In view of this .73 ratio and the .8 I believe we know that it will take about three broaches to put a hole through. It means on carrying the square out to a sharper corner; it means one more broach to a set. The fourth broach will carry it out readily.

H. L. Pope: I didn't read the paper carefully, but I didn't see anything in it about the size of the hole advisable to drill for a certain square. Now, in some parts you save the wear and tear on the broach, and you save the number of broaches necessary to use, if the diameter of the hole drilled is larger than the distance across the flats; and in a sliding gear I don't see as it does any harm, and it certainly gives better lubrication. In a press fit,—you may lose some of the fit by drilling a larger hole.

Mr. Bachuman. In regard to the matter of broaches, we have had some experience along the line of relieving the central portion of the flat side of the square hole as the gentleman just mentioned. In practically all of our sliding fits, in fact all of them, the drilled hole is a trifle larger than the short diameter of the square. I imagine that we probably remove in the neighborhood of about twenty-five per cent. of the flat side of the hole. I do not believe that will affect the efficiency of the hole, as a driving part.

In regard to spline shafting we do not use that in the transmission. But in commercial car practice, we had quite a little difficulty in the developing of the drivingshaft in the rear axle on the square driving line. We tried different kinds of material and did not find success owing to the weakening effect of reducing the round section to a square. It seemed almost impossible to take care of the severe shocks and jars which were produced by the destructive effect of the handling which the cars received in the hands of the operator. And so we developed a form of drive which gives us a very satisfactory drive, which was a multiple spine pole and shaft. We have about ten keys on the shaft of 1½ inch diameter. We have it divided in ten keys and spaces which are put in the neighborhood of 3/32 of an inch deep and about a quarter of an inch wide. I think you will find that figured out on that diameter. The flanks are not radial, but are on an angle,—an included angle of about twenty degrees.

Mr. Sweet: The early practice was to make the flat of the hole extend clear across and to make the flat on the shaft extend clear across. We milled out about one-third of the shaft, and we also enlarged the hole so that it cuts out about the central third of the flat, leaving about two-thirds of the natural flat. That, of course, helps the manufacture, because we can grind a good deal more in a day, and it is easier on the broaches.

So we practice to move about one-third of the flat by enlarging the hole. That works very nicely.

Mr. Spicer: One question came up as to whether it is commercially practical to get away from the big edge in the spline as well as you can in the square. There are so many surfaces on a spline fit. If we can get the bearing evenly distributed in the spline fit, it would seem to be better than the square, for the reason that all the pressure is direct, while on the square two-thirds of the pressure will not do any good. On the other hand the spline gives so many surfaces to finish, that it isn't so good for a commercial proposition.

Mr. Ferguson: The practice in Europe is the spline shaft for all transmission shafting and driving axle fits; I think it is a much better proposition. We are adding it largely on our five-ton truck. There is no difficulty in drilling the shaft. There is very little difficulty in broaching the hole. We thought it was a very difficult proposition before we started in on it, but we find it is not very difficult. We use the six spline and we can turn the shaft in any of the six positions, and we get a good fit.

Mr. Clayden: Mr. Ferguson is perfectly correct that the square shaft has almost disappeared in Europe. I don't think I could mention more than four firms who are using it now as a regular standard. I believe that it is probably because it is easier to get a quiet running gear box if you use spline shafts instead of square shafts. The idea is that as the shaft revolves they spring every time the short diameter receives the load. Well, that looks of course like a matter of small proportions, but this question of gear noise seems to be entirely made up of the summarization of infinitesimals, and that very likely is one of the things that has an effect. I have never heard that people have had a great deal of difficulty in getting as good a fit on spline shaft as on the square shaft. And from personal experience I should say that the spline shafts wear considerably better; that an old spline shaft that had gears sliding up and down on it for a year or two was in better condition than a square shaft of similar age.

I don't think, really, that the proportions of the spline, from my personal experience, seem to have any effect upon the durability or any effect upon the fit, though I should imagine the larger the splines the easier it is to get the fit really satisfactory. There is a slight tendency to use a long key instead of the spline. There are two or three firms who have been experimenting with that. I don't know whether anybody has taken it up. The idea was that they could harden and grind the keys in the shop and so get the diameter near perfect even there and after the keys were fitted in they could be ground again so that you have both large and small diameter of the shaft ground accurately.

Mr. Wall: It has been my experience that the spline gives better results but that on account of the manufacturing difficulties,—that, although it is easy to make a square shaft and a spline shaft,—that the gear itself is so much easier made in using the spline shaft that it is probably better to use the spline arrangement. If it were not for the necessity of grinding gears, I do not believe this proposition would be so important. But if the gears are hard and they have warped to a certain extent, and if you have a square hole, it is almost impossible to grind the hole out. Whereas, if you have a spline shaft, it is very easy to grind it out to get it back to the original dimensions.

Mr. Spicer: The last member brought up a question that came up in committee meeting, and I would like to ask them what surface should be ground for a spline fit.

MR. BERGMAN: I would like to make a motion that the broach division suggest a standard size for the different sizes, so we can get our broaches in stock.

MR. PERRIN: I should think it would be wise to have two standards, because if there is a standard for either of us,—a great many of us may have parts reaching to both fields, and for that reason it would be wise,—although it might increase the field of that committee too much,—I should think we ought to have a standard for both spline and square.

MR. BIRDSALL: There are certain places that I don't think we could use the spline. In the worm wheel I know from personal experience that it is a great thing that we have a square standard. Of course, that is a fixed fit. I don't see how a spline fit would be good in that case. I think we should have two standards, one on splines and one on squares.

MR. HINKLEY: I have had some experience in spline work. I found that in transmission gear work that an even number of splines is not as satisfactory as an odd number. In referring this to the standards committee reference was made whether the splines should be an equal or odd number for that work. And another thing, the spline shaft is a more economical proposition than a square. The square in order to get sufficient material to do the work has generally got to be upset, whereas the spline can be taken out of stock sizes, and is more economical.

MR. H. L. POPE: I feel that the Standards Committee should work on both ends. I feel sure that there are certain manufacturers that wouldn't change to the spline keys for a good many years, and I feel that also for a good many years there will be places on the machines where you will have to use both; therefore I think that they should get up a standard for both the spline shaft and the square.

MR. FAY: The proportion of the shaft makes a certain amount of sticking trouble in some cases, and I should think that the clearance of the sliding fit should be stated in terms of the length of the sliding gear hole.

MR. GARGEAU: I believe it is the intention to recommend that the bearing and on top of the spline, that is, the outside diameter of the shaft be ground, and the hole in the gear and the other possibly to be left as it comes from the manufacturer.

MR. BIRDSALL: I would like to say for information that at least eighty-five per cent of the steering geers at the present time being sold and used are made with a square at the end of the front wheel shaft. I have traced seventy-five and I know I missed a lot of them.

PRESIDENT: The next paper before us is on Worm Gears and Wheels, by E. R. Whitney. I would suggest that it be read by title as the paper has been in your hands. There is one error on page 11, in the table at the right-hand side, where it reads, "Gears, ratio of 6 to 1; of 14 to 1" on the right of that the paper should read, "higher than 14 to 1." Then below that the Editor of the paper has provided a heading there that I am afraid misconstrues a little the intention. The heading reads, "Worm Gear Inapplicable to Pleasure Cars and Heavy Electric Trucks." It is not inapplicable to any of those except on the score of the limits pointed out in an earlier part of the paper. I would change the heading like this: "Legitimate Field for the Worm Gear."

MR. WEAVER: In connecting work of this kind, it has been customary to use fourteen and a half degrees, but I think it is necessary to use something greater. In Europe the angle used runs from twenty-two and one-half degrees up. I think it is twenty-five degrees in some instances.

Also, the ball thrust bearing for the worm. There seems to be a great variation in practice in the European people of the thrust bearing. Some of them use a very small number of balls with large diameters. Others use a smaller ball and greater number, and both seem to get away with it. But it looked to me like the large balls are much better.

MR. TRASK: I would like to call upon Mr. Sweet. I think I saw a Cadillac going down the avenue with a worm drive on it. I don't know whether it was right for me to see that or not, but I think I saw it.

MR. SWEET: I guess Mr. Trask is right, but I am not prepared to talk about it.

MR. D. E. ROSS: The main thing to be watched is the helix angle; in getting the correct helix angle and the pressure angle;—and also the pitch of the gear.

MR. BIRDSALL: I have had occasion in the last year, like everybody else, to look into the worm gear. I have also had a friend of mine,—an engineer over in London who has attempted to keep me informed as to what they were doing over there. The main success of the English gears as I get it from him is due to the fact that the tooth is a special shape, that the general shape of the teeth is an equilateral triangle. Another important point is that the worm wheel shall be polished to a clear mirror-like finish. The worm is of hardened steel and the worm wheels of special bronze.

Another point is that the housing should be very rigid; also that the fastener of the thrust bearing bear a great part in the gear; especially in those of the Hindley type.

MR. RUSSELL: Our experience with the worm drive has come from observation of it in England and from observation on a fairly limited number of English cars imported with the worm gear into Canada. From these observations, I became quite a convert to the worm gear, as it is in England. I don't think there is any doubt but what the Lanchester gear,—but what it compares well enough in the matter of efficiency to hold its own with any other form of drive. I don't think there is any doubt about its durability. In the operation of cars of the same horsepower, there did not appear to be any noticeable difference in the performance that I detected, unless perhaps one detected a very slight difference at extremely slow speed, due to the disadvantage of the worm.

Our trouble so far has been that conditions in our travel are so different from England, on road clearance, and it seems necessary to place the worm on top, which brings up the question of body clearance. It seems to me that the close results in efficiency and in cost are going to lead the problem to be solved differently by the two countries. There is no doubt in my mind of the continued increase of it in England and on the Continent. I know of two of the large makers of cars over there who wouldn't listen to the worm drive being put on their cars two years ago who are adopting them for the coming year. In this country it would seem to me that the adoption of the worm is really going to depend upon the perfection or lack of perfection of the bevelled gear. If the noise could be satisfactorily removed from the bevelled gear it is possible that in this country the clearance question would decide it in favor of the bevelled gears.

MR. BIRDSALL: At the present time there are running in Detroit two cars with bevelled gear drives on which the teeth of the bevelled gears have been ground. They have been ground on a new machine to an absolutely smooth finish. The shape is theoretically perfect. These gears are practically as quiet as any worm, and the matter of adjustment doesn't seem to be very important. They can run with their circles both in and out, and it doesn't seem to make any difference in the noise of the gears.

MR. FERGUSON: There are two distinct fields. One is the pleasure car field, in which we are using either bevel or worm. There is only one thing in favor of the worm and that is it is silent. There is nothing to it in the way of efficiency. The only thing in it is for the silent running.

There is another field, and that is the field we have introduced the worm that is the commercial end. I don't think there is any question at all as to its greater adaptibility and stability for that kind of work. It has no competitor. The only competitor it has possibly got is the beveled gear, and I don't think there is anybody that will contend that that is as efficient as the worm gear. I don't want to say anything against the chain drive, but I think that is double the life of the chain drive. And I think you get equal efficiency at any rate and I think greater efficiency in the worm gear, and with the double life I think it has no competitor.

We are using the straight worm. It is the same worm gear that Denis is using. The worm is made of hard steel. The wheels made would be ground on a cylindrical shaft and your worm wheel, if it doesn't show a good bearing in one hour's running,—after a day or two days' running will show an absolutely perfect running. And it keeps that way until the thing is worn out. And is still an efficient proposition until it is practically a dead one. It still keeps its efficiency. There is no drawback on account of the worm wheel. It may be a disadvantage in a pleasure car if you cannot get your seating capacity. But in the worm itself, there is absolutely no disadvantage. In the commercial field it is admirable. So I think that our firm is in favor of the worm gear.

MR. SLADE: If you want to use a live rear axle on the heavy capacity truck you must either use a bevelled gear or a worm drive, and it is for the designing engineer to decide which of these combinations he considers most advisable and practical. My personal preference is with a dead rear axle with side rear drive. I don't think the question is between side chains and worm gears, but between live and dead rear axles.

MR. DONALDSON: There is another point that I think is somewhat lost sight of in the application of worm wheel. The live axle is the principal one and it was not discussed until mentioned by Mr. Slade. The other one is the inability of the worm drive to make easy change of gear ratio. It is very desirable sometimes to make some change from the standard practice, and I would like some one to give us some little information as to how it can be gotten around by the worm drive. I think the large amount of success of the worm drive has been in the work in which it is best adapted to,—in the commercial field,—when they know before the machines are installed just exactly the amount of stops and the kind of pavement and the nature of the roads,—then it seems it is easy to meet the conditions. But in the large number of truck installations the maker rarely knows where the machine is going to be used or how it is going to be used, and I think that must be borne in mind in the consideration of any form of mechanism.

MR. SWEET: I might give some impressions that come to us in experimental work, more or less, with worm gear drive. First, the finish of the teeth is very important. It should be as near a mirror finish as possible. Another is that the mounting of these gears has to be very positive. Another is a good thrust ball bearing, because the gears become notched if the bearings yield a little bit. I believe Lanchester uses the straight worm and wheel on cars up to thirty horsepower, and on thirty to fifty he uses the throated worm. But where you have the throated worm it becomes a very difficult problem to set them. A movement in any direction is serious. It is a very much simpler problem to use a straight worm with throated wheel.

MR. E. V. ROSS: Mr. Donaldson brought up a most important thing in the worm car drive business. I had that trouble right from the start to get interchangeability of the gears, from the same pressure angle and the same helix angle. We worked at it and find that with an angle whose tangent is one-half, an interchangeability of gears by increasing or decreasing the number of teeth in one and increasing or decreasing the number of teeth in the drive wheel two, that will give a pretty good change, by using the same centers and same helix angle and same pitch. We couldn't get the exact number of ratio that we would like to have. But we have a seven to one, and nine to one, and we could have gotten five to one; and that is the only angle that we found would do the business.

MR. CLAYDEN: As far as England is concerned, I am confident that the bevel axle will decrease in numbers very greatly. I think that for all pleasure car work the worm driven axle is going to become the standard type. Of course in England you still hear a great deal about the inefficiency of the worm, but that is undoubtedly because the manufacture of a successful worm gear and wheel is an extremely difficult matter. I believe there are not more than five, or at most, six firms in Europe, entirely independent of each other, who can manufacture successful worms and wheels. Mr. Lanchester was the first man in England to make successful worm, and his experience has been passed around to three or four of the leading manufacturers; so that several of the worm gears which one would find now would never have come into existence had it not been for Mr. Lanchester. He has always supported the Hindley form of worm, and the mathematics of the Hindley worm are entirely too intricate for me, for I am no mathematician at all. But I have never been able to find any superior over the Hindley worm.

The straight worm is used in the Dennis cars, which I believe were designed by Mr. Brown. I think he was almost entirely responsible for the Dennis design. These have been as durable as the Lanchester.

As regards the pressure angle, I believe the Daimler company have made some extensive experiments there, I think they are using in the neighborhood of twenty-two degrees. There is one rather interesting thing about the manufacture of bevelled gears.—The great popularity of the worm axle rather dates from some experiments made by the Daimler company which may have started it. Of course the Daimler car of 1906 was an extremely successful car and frightfully noisy. There was an indirect drive on all four speeds; and so the next year they had two spiral drives in the gear box and the bevelled axle. Well, that made things a great deal better, but the spiral drives were not very satisfactory, and they found that even the bevel was not so conspicuously more silent than the chain, and so they proceeded to try to get the bevels right, and last year they made bevels for the cars in the following way: They were first cast and then finished on a special machine; and they were then hardened and taken into a special room where they were fitted up on a shaft. They were run around altogether, and then every high spot was removed by hand, and sometimes they took as long as two days to finish a pair of gears. And after a few more days on the road they would turn out an axle which was as silent as a worm driven axle,—but naturally the worm is a great deal cheaper.

Of course, the question of noise is receiving the most rediculous attention in Europe. The people have got so accustomed to the excessively quiet car that even the smallest noise will cause great consternation. I know practically every manufacturer is getting letters every mail complaining of something or other in the way of noise.

I believe next, as regards the accuracy of manufacture,—I think that the finishing of surfaces and material used is more important than the teeth shape. The teeth shape is certainly very important, and the equilateral triangle is a very good one. But no shape of teeth will save you if your material is not hard. Several people that started out to make worms lightheartedly, soon gave it up. The worms are only being made by very few people, simply because it doesn't pay to do it.

The diameter of the worm varies very slightly with the pressure angle. I don't know as any exact reason has been found for this, but there is no doubt about it. But worms designed along the same line and made in the same way give different results entirely.

On body clearance: There are several gears in England with the worm above the worm wheel. There have been small body clearance troubles, but I think they have been overcome now. They are overcome principally by inclining the transmission upwards to the back axle and leaving room under the center seat to allow for the rising of the axle.

Mead Rotary Valve Motor

Showing the design and construction of the Mead Rotary Valve Motor, made in Dayton, Ohio. In order to obviate the inconveniences of temperature changes, two valves are employed, driven by worm gearing with plenty of provision for cooling. Apart from the valve the motor follows up-to-date practice, utilizing the vertical shaft for operating the pump and magneto.

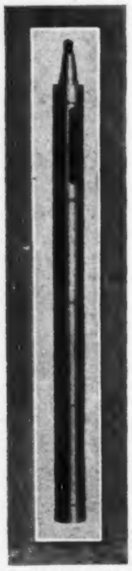


Fig. 1—The Mead Valve

REDUCTION of working parts and fool-proof simplicity are the keynotes struck in the design of the Mead rotary valve motor. As will be seen from accompanying illustrations, the construction of the motor does not differ materially from the conventional form of internal combustion four-cycle type with the exception of the valves. These are true cylinders throughout their entire length, and, as shown in Fig. 1, have four slots. In the illustration there are also oil grooves, but in future motors these will be eliminated, as it has been found in practice and experiment that they can be dispensed with. The valves themselves are made of ordinary gray cast iron similar to that used in cylinder castings, but in order to relieve casting strains that might be occasioned by the heat of the gases and cause warping of the valve and resulting binding in bearings they are annealed beforehand. After the cylinders have been carefully indexed for the proper angles of opening the slots are cut by a slotting milling machine. The hole within which the valve rotates is likewise cylindrical and the clearance allowed is .0015 inch at the five bearing points and about .0005 inch more clearance in the zone opposite the port opening. It will be seen that the end of the valve is tapered and screwed in order to accommodate the gear wheel that drives it. These can be seen in Fig. 2, where the wheels G and G1 are driven on

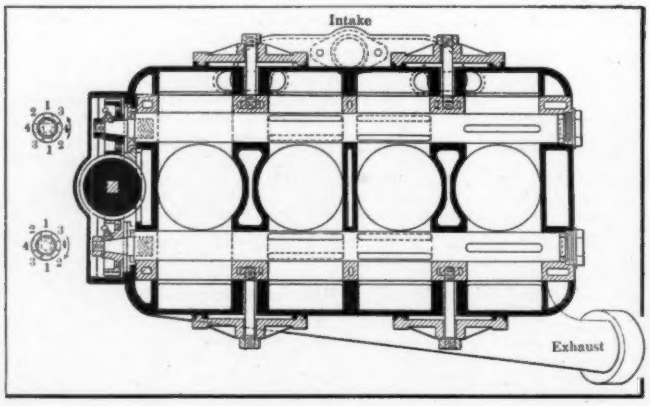


Fig. 6—Plan view of the motor in section, showing the relation of the cylinders, valves and ports

the taper shown in Fig. 1 and are held in place by nuts and lock washers. This method of attachment allows any alteration of the timing which would otherwise be impossible if keys were employed. A set screw through the hub of the gear bears against the taper shaft and assists in keeping the gear from rotating on its shaft. As the valves are built with a view to silence, gear noises are eliminated by the use of worm gears. As indicated by the oil grooves in Fig. 1, there are five bearing surfaces on each valve, cast iron to cast iron, and each one of these is lubricated by force feed, the piping being shown in Fig. 3 at O1, O2, O3, O4, O5, and it is stated by the makers that very little oil is necessary to take care of this. The rotary action of the valve gives to the bearings a polished surface

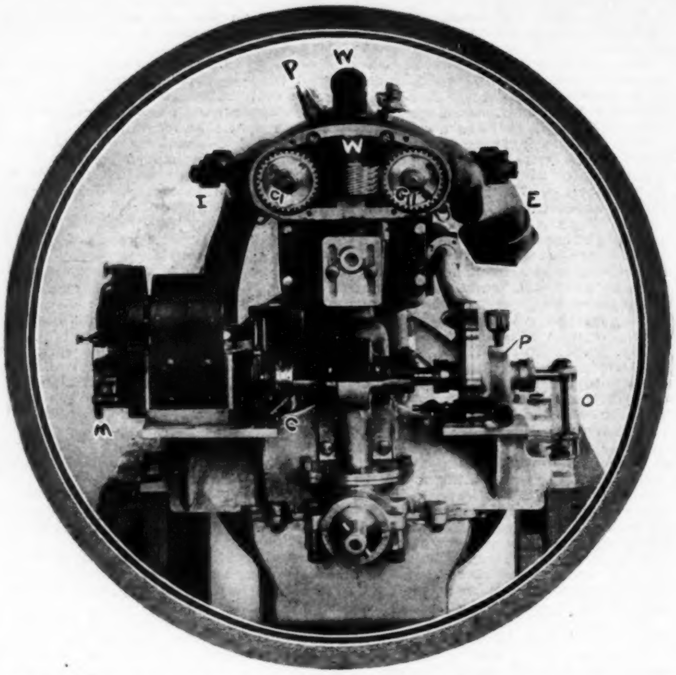


Fig. 2—Front view of the Mead motor with the timing gear case removed

much the same in appearance as that obtained in a cylinder. The boring of the valve hole is effected by a boring mill and afterwards finished with a long reamer to insure truth, and the fit of the valve proper is attained by grinding. The bore of the motor is 4 inches and the stroke 4 1-2 inches and the valves are 1 3-8 inches in diameter. The openings of the exhaust ports, which may be seen in Fig. 1 and at P in Fig. 3, are about 3-8 inch wide and the length of the slot is nearly as long as the bore. The diameter of the inlet valve is the same as the exhaust, but in this case the width of the port is less. The engine develops 31 to 33 horsepower in the region of 1,300 revolutions per minute. The size of the port varies the timing considerably, but with a 5-16 inch intake valve slot the valve begins to open about 10 degrees past upper dead center and closes about 40 degrees after lower dead center, remaining

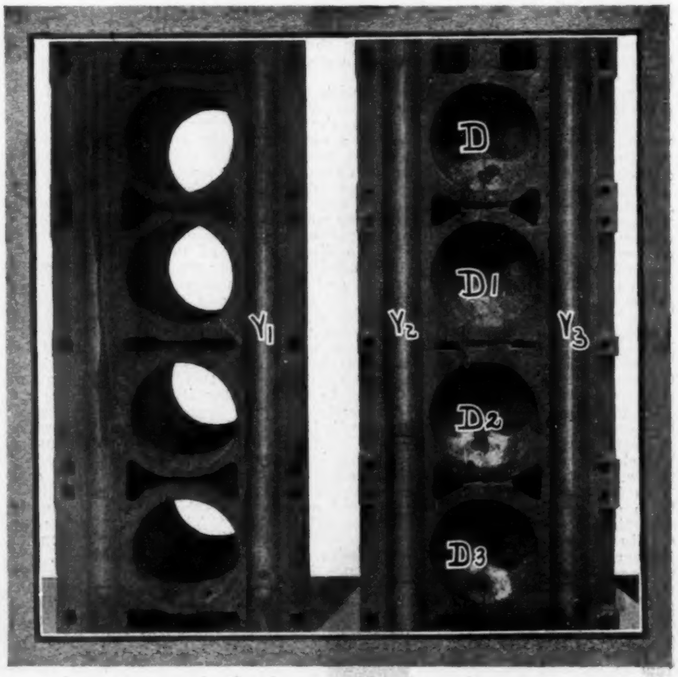


Fig. 4—Two sectional views of the cylinder casting, also showing the valve holes

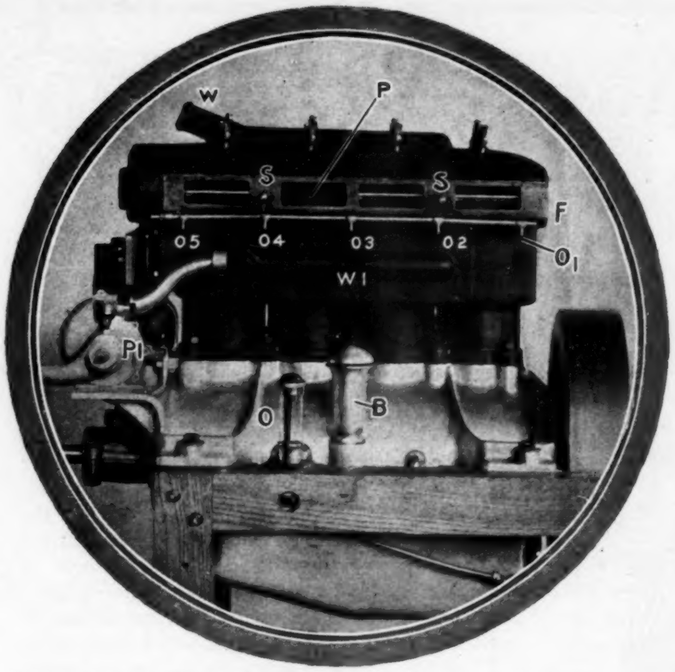


Fig. 3—Exhaust side of the Mead motor with the manifold removed and the rotary sleeve valve in sight

open about 260 degrees. The exhaust valve with 3-8 inch slot closes at upper dead center and begins to open at about 75 degrees before the lower dead center. The lubrication of the intake valve has been accomplished by feeding a manifold to the inlet side of the motor, which has five openings to the intake valve bearings and is fed by one lead from the force feed oiler.

It is claimed that by using two rotating valves the passage of the gases is thereby simplified, which no doubt is true, and temperature changes are not encountered. The water jacket that surrounds the valves maintains them at a uniform temperature, and by this means there is no tendency to warp due to the differences that would be felt were both the incoming and cold gases and the burning exhaust to pass through the same valve.

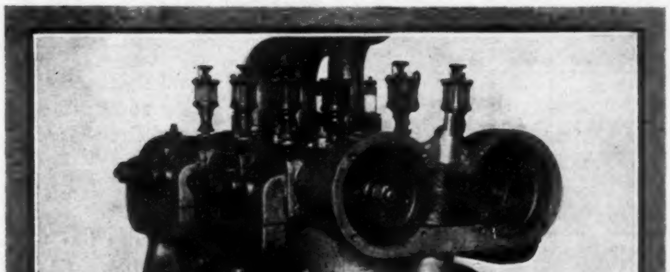


Fig. 5—Earlier type of Mead motor from which the advance in design in the new model can be seen

Fig. 3 shows the exhaust side of the motor with the exhaust manifold removed, and it will be noticed that the valve can readily be inspected. The manifold is held in place by two bridge pieces and nuts that screw onto the two studs S and S. The upper and lower sectional views of the cylinder can be seen by referring to Fig. 4. The valve grooves V, V1, V2, V3 can be seen, also the spaces for the water circulation. The cylinder domes D, D1, D2, D3 will be noticed, and into these are drilled the spark plugs and pet cocks as shown in Fig. 1. This illustration shows the method of driving the pump and magneto, which are respectively placed on ledges cast integral with the upper half of the base chamber. This method of attachment leaves the magneto very easy of access. The intake manifold I is bolted to the cylinder casting in a similar manner to the exhaust and a Schebler carbureter is used. In order to obviate several unions in the water circulating system the method shown in Fig. 3 is commendable, as by removing the plate it is

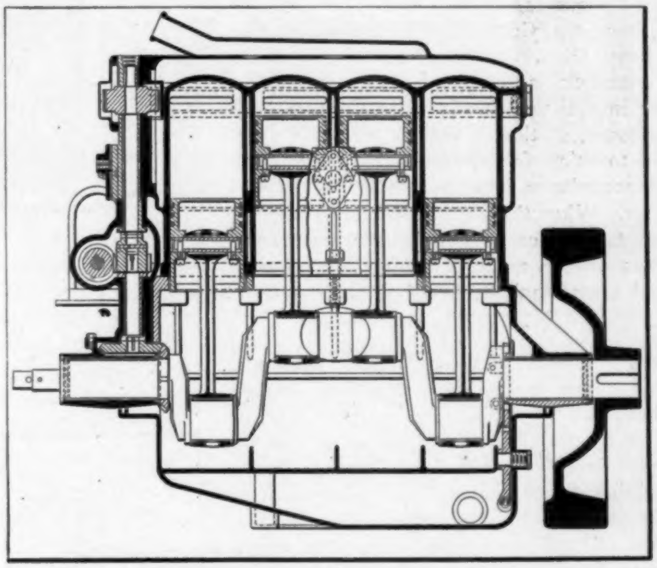


Fig. 7—Sectional side view of the Mead motor, showing the bevel driven vertical shaft and the two bearing crankshaft

possible to thoroughly wash the passage-ways out around the cylinders and remove the scale that is liable to form therein.

A clear conception of the operation and working of the cylindrical rotary valves may be obtained by reference to Fig. 6 which is a plan sectional view of the motor, the firing order being 1, 2, 4, 3, as indicated by the diagram. The following is a table of openings expressed in degrees for 1 3-8-inch diameter valve that it is possible to obtain, taking the length of the slot to be 3 3-4 inches:

The length of the valve slot is 3¾".

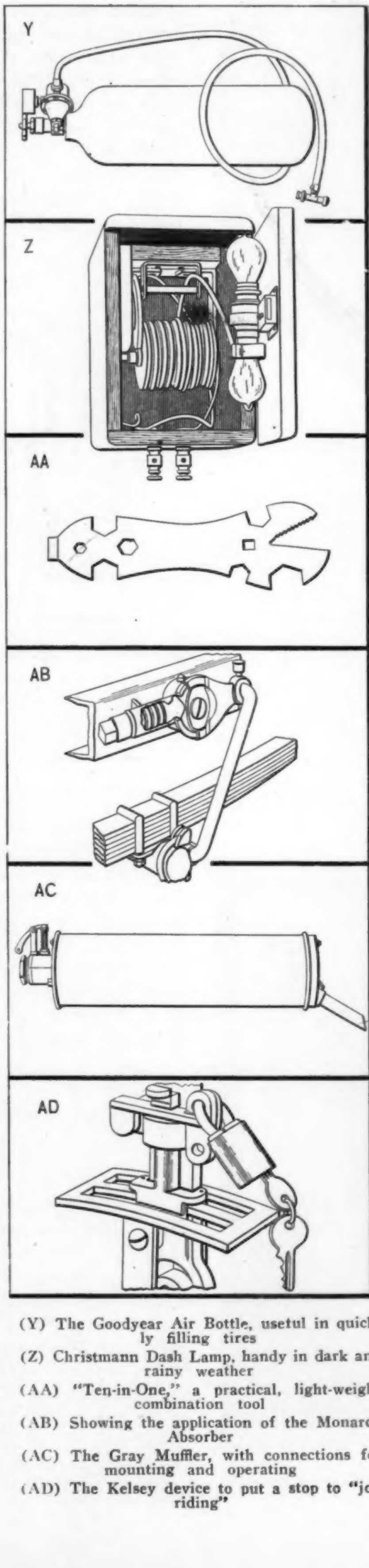
Area of valve slot in square inches.	Slot width in fractions of an inch.	Slot width expressed in decimals.	Degrees opening of 1⅜" dia. Intake or Exhaust valve remains open.	Degrees on flywheel that the intake or the exhaust valve remains open.	With exhaust valve closing on U.D.C. it opens degree from L.D.C.	With intake valve opening of 10 degrees past U.D.C., it closes 1 deg. from L.D.C.
1.5313	7/16	.437	37.0	295.0	+ 116.0	— 126.0
1.4219	13/32	.406	34.3	274.4	+ 94.4	— 104.4
1.3125	3/8	.375	31.6	252.8	+ 72.8	— 82.8
1.2031	11/32	.344	28.9	231.2	+ 51.2	— 61.2
1.0938	5/16	.312	26.2	209.6	+ 29.6	— 39.6
.9844	9/32	.281	23.5	188.0	+ 8.0	— 18.0
.8750	1/4	.250	20.9	167.2	— 12.8	+ 2.8
.7656	7/32	.219	18.2	145.6	— 34.4	+ 24.4
.6562	3/16	.187	15.6	124.8	— 55.2	+ 45.2
.5468	5/32	.156	13.0	104.0	— 76.0	+ 66.0
.4375	1/8	.125	10.4	83.2	— 96.8	+ 86.8
.3261	3/32	.094	7.7	61.6	— 118.4	+ 108.4
.2168	1/16	.062	5.1	43.8	— 139.2	+ 129.2

Seen in the Show Window

CORRECT tire pressure is a recognized necessity, and taking along a Goodrich bottle (Y) of compressed air will be an insurance along these lines, all that is necessary to inflate a tire with this bottle being to open the outlet valve for the compressed air and holding the end of the hose connection against the tire valve. A tire gauge will be used to advantage to indicate the proper pressure of the air in the tire, the correct amounts for their various tire products being given out by the makers, the Goodrich Tire & Rubber Co., Akron, Ohio. The air bottle shown in the illustration is made of strong steel, the air in the tank being under a very high pressure, so that it suffices to inflate from six to thirty-five tires, the variation being in accordance with the several sizes of tires. When the compressed air is used up the tank is exchanged by the representatives of the makers for a slight charge, and a new tank delivered to the customer.

ON a dark and rainy night, wind and rain in the most annoying manner thwart all attempts to use matches, and the wise automobilist should see to it that his outfit includes a sufficiently strong electric lighting device, making him independent of the inclemency of weather. The illustration (Z) affords a view of the Christmann Dash Lamp, made by the Penn Auto Supply Co., Philadelphia, Pa. This lamp is compact and practically infallible as long as battery, wiring and bulbs are kept in order. Two lamps are screwed into a double plug, and the insulated wiring runs from the two terminals over a geared spool to the lamp, which is placed on a hook on the inside of the door. The wire is of sufficient length to permit of applying the light to any part of the car that it is desired to inspect.

COMBINATION tools represent a high degree of economy, in that they take up comparatively little space, are of light weight and obviously very practical. As an example of this class of appliances the "Ten-in-One" combination tool (AA) is herewith illustrated, and it is clearly seen that the device is equally useful as a wrench and spanner, the several indentions being made to fit nuts and plugs of various standard dimensions. A further feature of this accessory is that it fits the nut used on Prest-O-Lite tanks, thus appealing to a great number of automobilists. The weight of the device is but six ounces; it is made of tempered cast steel with blue finish, and 9-32 inch thick. J. Stewart Smith, of 1779 Broadway, New York, is the maker and seller of this little tool.



(Y) The Goodyear Air Bottle, usetul in quickly filling tires

(Z) Christmann Dash Lamp, handy in dark and rainy weather

(AA) "Ten-in-One," a practical, light-weight combination tool

(AB) Showing the application of the Monarch Absorber

(AC) The Gray Muffler, with connections for mounting and operating

(AD) The Kelsey device to put a stop to "joy riding"

THE introduction of a secondary shock absorber, taking off some of the duty of the springs, is a desideratum in touring, and among the several products made and using various principles to attain the end, the Monarch absorber, which is seen at (AB), should be mentioned. Its principle is the application of an eccentrically rounded surface seen in the portion of the device which is attached to the chassis, the eccentric bearing against the absorber spring. If the chassis is thrown up or suddenly falls down, the link containing the eccentric is forced out of its horizontal position, thereby increasing the pressure of the eccentrically rounded member on the absorber spring. This latter gives way to the pressure but slowly, so that the energy of the shock is taken up by the successive adjustment of the spring. The absorber is sold by Charles M. Green, Boston, Mass.

SILENCE of the exhaust of an automobile cannot be had except at the price of some of the motor's power, the principle of the muffler or silencer being the handicapping of the hot and expanded gases leaving the motor after having been expelled by the piston. The noise of the unhampered exhaust will be understood when one considers the fact that air, primarily under a pressure of 14 pounds per square inch, rushing into a vacuum of 30 inches, moves at a speed of 800 miles an hour. The manner in which silence is attained is by interposing a resistance to the gases on their way into the air, the muffler containing a number of perforated plates or overlapping planes, which obstruct the flow of the gas. The Gray muffler (AC) represents an efficient design, and together with all connections for mounting and operating it may be obtained from the Gray-Hawley Mfg. Co., Detroit, Mich.

THERE is a way to prevent "joy riding," and the illustration (AD) clearly shows its efficacy. An automobile cannot run except with the gears in mesh; in other words, so long as the speed-change lever is in its neutral position the machine cannot be moved from its place by the power of the motor. The device shown consists of a sleeve closing around the transmission lever, and preventing its removal from neutral when the lock is in place, holding the two jaws of the device in secure relation. A Yale lock serves to secure the device, and gives the owner or driver absolute protection against any intruders; so long as he is the possessor of the one key which is furnished. This device is the product of F. H. Kelsey & Co., 408 Frankfort Avenue, Cleveland, Ohio.